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ABSTRACT

This experiment was designed to investigate the relative value of three sources of cue (graphic stimulus only, graphic stimulus plus a picture cue, and graphic stimulus plus a context cue) in combination with two list types (minimal and maximal contrast) as a means of facilitating the acquisition of initial reading vocabulary. The subjects, 137 first graders, were randomly assigned to treatment groups and were given four types of tests: the learning test trials used to evaluate progress during the learning session; a 24 hour test used to evaluate retention of the words; a posttest used to evaluate retention of the words over a longer period of time; and a transfer test used to evaluate the ability to recognize unpracticed words that used the same initial and final elements as those used in the practiced word lists. The analyses of the correct answers made on each source of cue combined with each list type resulted in three sources of variation which were significant or approached significance on all tests. The main effect of high and low ability grouping, minimal and maximal contrast list types, and sex was significant. (WR)

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AN INVESTIGATION OF LIST TYPES AND CUES TO FACILITATE INITIAL READING VOCABULARY ACQUISITION

by

Ruth Norene Hartley

TECHNICAL REPORT NO. 132

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CHAPTER I

Background and Theoretical Considerations of the Study

Learning to read is a complex process involving the acquisition of a variety of skills. The skills required to be an effective reader are indicated by the tasks and the instructional procedures for each task that are included in any standard reading curriculum. Therefore, one needs to understand each problem type and how each problem type is learned and mastered by the student, as well as how the various problem types integrate with each other, to develop an effective reading program.

One skill basic to the total reading process is word identification or reading vocabulary acquisition. Word list learning as one method of acquiring a reading vocabulary is present in any reading curriculum regardless of the theoretical basis for the curriculum.

Because the theoretical bases for reading curricula are so varied, a number of approaches have been used for initial reading vocabulary acquisition. The problem of initial reading vocabulary acquisition has been studied in reference to minimal and maximal contrast word lists and sources of cue related to the "meaning" of the word. The sources of cue usually considered are: 1) the word itself, 2) picture cues, and 3) context cues. The evidence on the relative value of each list type and source of cue is not only limited but also contradictory. Because of the limited and contradictory evidence, this study was designed to investigate the relative merit of each list type combined with each source of cue.

Word List Types

Two principal types have been investigated: 1) minimal contrast word lists, and 2) maximal contrast word lists. Some investigators such as Fries (1963) and Bloomfield and Barnhart (1961) have considered minimal and maximal contrast lists as having different purposes in the learning situation. The minimal contrast list has been considered by these investigators to teach sound-symbol relationships while the maximal contrast list has been considered to teach word recognition. Other investigators such as Gagne (1950) and Rotberg and Woolman (1963) have considered the two list types as sources of cues having generally the same purpose in the learning situation. For the purposes of this investigation the latter position was adopted, that is, the list types were considered as cue sources.

Minimal Contrast Word Lists. A minimal contrast word list is one that includes words in which certain elements are held constant in each word and one element varies. For example, a list of words such as hen, men, ten, pen, would be considered a minimal contrast list. In this list the final two elements (en) of the words are held constant, the first element varies.

The theoretical support for the minimal contrast list comes from such linguists as Fries, Bloomfield, and Soffietti. For example, Fries (1963) would select an initial reading vocabulary to conform to the "regularities" which the minimal contrast word list exemplifies. He would begin initial reading acquisition with short words containing graphemes (letters) with one phonetic value. To accomplish the task of reading vocabulary acquisition, Fries would program the material for the student in a step-by-step progression through the basic regularities (minimal contrasts) of the language. Only after the child has developed competence with the regularities would he be exposed to the irregularities.

Bloomfield and Barnhart (1961) also felt the children should be first introduced to these regularities. He would also begin by teaching monosyllabic words having a regular grapheme to phoneme correspondence.

Similarly, another linguist, Soffietti (1955), has asserted that a child could not readily learn word discrimination if forced to deal initially with the phonetic inconsistencies of the language.

Experimental support for the preceding position comes from psychological investigations. Levin and Watson (1961b) found that the learning of a constant or patterned list was significantly faster than the learning of a non-patterned or variable list. In a similar study Levin, Baum, and Bostwick (1963) concluded that when regular correspondences have been learned, a constant list facilitated transfer learning faster than a variable list.

Gagne (1950) compared similar and dissimilar stimulus groups for the use of stimulus material composed of nonsense forms. He found that the subjects given learning groups of similar stimuli did better during the testing than did those given dissimilar groups. He interpreted the results in the terms of the hypothesis that similar learning groups provided more opportunity for learning the cue relevant to the response than did dissimilar groups. Rotberg and Woolman (1963) also found that learning was more effective when groups of stimuli were composed of similar items. These investigators concluded that stimulus similarity decreases discrimination difficulty while increasing the opportunity for "coding."

Maximal Contrast Word Lists. A maximal contrast word list is one in which no elements of words are held constant. For example, a list of words such as rake. show, king, ten, can be considered a maximal contrast list. The support for the use of maximal contrast word lists comes largely from educators who have specialized in reading pedagogy. The position rests largely on early work by Catell (1885) and Erdmann and Dodge (1898). Their tachistoscopic experimentation seemed to indicate that in a given unit of time only three or four unrelated letters could be recognized but that in the same unit of time as many as a total of twelve letters could be identified so long as the letters combined to make words.

In a more recent work, Rothkopf (1958) found that lists which have perceptual differences among the items comprising the list are more rapidly learned than lists with small or minimal differences among the items. The results of four studies by Underwood (1952, 1953a, 1953b, 1953c) indicated that the higher the intra-list similarity the more difficult the learning and the relearning. Levin and Watson's (1961a) analysis of the confusion errors on word lists indicated that words which share an initial grapheme and phoneme are most confused with each other, those which share terminal elements are next as a source of confusion, and words with no common elements are the least confused.

Meaning Associations with Word Lists

The problems of associating a "meaning" with the words (whether in minimal or maximal contrast list types) acquired in initial reading have been studied in reference to: 1) graphic stimulus plus a picture cue, 2) graphic stimulus plus a context cue, and 3) the graphic stimulus alone.

Picture Cue. A picture cue is one that uses a pictorial representation of the object, action, or other semantic content of the word. The theoretical basis for a picture cue to stimulate meaning association is largely an exercise in plausibility. It is assumed that the picture representing the semantic content of the word will help the child associate "meaning" with the word. Heilman (1961) has stated; "Pictures which are used quite profusely in beginning reading materials, are of considerable help in arriving at unknown words." Betts (1957) has indicated that pictures not only make the book more attractive but they facilitate comprehension. Smith (1963) has maintained that the pictures offer the child valuable assistance in making the transition from recognizing a symbol that stands for the object and naming it. In contrast, Fries (1963) regards pictures as distracting and uses none in his instructional programs.

The investigations of pictures as cues to meaning are contradictory. Malter (1948) indicated that very little is known about the way a child perceives a picture. Vernon (1958) indicated that although children might enjoy pictures, they failed to notice what the adult noticed in a picture. She also found the children were unable to determine a course of action from a picture until they were nine or ten years of age.

In two experiments, Samuels (1967) found that a picture may miscue or divert attention from the printed word. The first experiment was conducted in a laboratory situation. Randomly assigned first-graders learned to read four words with no pictures or a simple picture or a complex picture present. During the acquisition trials, when pictures were present, the simple and complex picture groups made significantly more correct responses. During the test trials, with no pictures present, the no-picture group made significantly more correct responses. In a second experiment 26 matched pairs of first-graders were given classroom reading instruction under a picture or a no-picture condition. The results disclosed that poor readers with no picture present learned significantly more words. Among the better readers the differences were not significant.

In contrast, a "visual method" (sight-word approach) and a "picture story" method of beginning reading were compared by Bergman and Vreeland (1932). The children who received their initial reading instruction by the "picture-story" method made superior scores in word recognition. Similar results with the use of pictures were obtained by Dice (1942) in a methodology study on beginning reading for first-graders.

From the research on teaching foreign languages we also find some evidence pointing to the value of a picture cue. The beginning reader may be compared with the beginning learner of a foreign language in that both are learning a new code. Studies such as the ones by Kale and Grosslight (1955) and Kopstein and Roshal (1954) indicate that the words of a foreign language are best learned when presented in association with pictures of objects, actions, or other semantic content.

Context Cue. A context cue is said to be present when the sentence indicates the "meaning" of a word. Those interested in reading pedagogy have long made a distinction between a word in syntactical context and a word in isolation, implying that "meaning" is more easily derived in such context. For example, Gray (1960) has maintained that the first words the child learns to read should be presented in context. Tinker and McCullough (1962) have also asserted that instruction on words in context is valuable but that teaching words in isolation is ineffective.

Recent psychological research has also emphasized the importance of meaningful associations in learning. Noble and McNeely (1957) and Underwood and Schultz (1960) indicate that context is anything that would provide more associations and meaningfulness to the materials to be learned. If sentence context does indeed provide these associations and meaningfulness, then word acquisition should be facilitated. Brown and Berko (1960) found that subjects who were introduced to nonsense syllables even in sentences "lacking semantic quality," that is, having minimum "meaning," were able to use those nonsense syllables correctly in other sentences. Brown (1958) found that the syntactic properties of a word did provide clues as to its meaning, and therefore, concluded that the introduction of a new word in context should aid a child in learning a new word.

In second language learning for college students the usual finding is also that vocabulary acquisition is facilitated by context. Morgan and Foltz (1944) and Miller and Selfridge (1953) are typical studies. In contrast, Siebert (1930) found paired-associates were learned faster than those learned in syntactical context. In a more recent experiment on second language learning by Crothers and Suppes (1967), college freshman were taught Russian by two methods. One group learned individual words during the training sessions and the other group learned the same words but the words were used only in sentences during the training sessions. These experimenters found that those subject who learned individual words during the training sessions excelled in the test situation on both individual words and sentences. The research from second language learning provides contradictory evidence for the use of context cues.

Graphic Stimulus Only. The theoretical support for concentrating on the word itself in initial vocabulary acquisition also stems from the work of Fries and Bloomfield. Fries (1963) indicated that the child already has oral control of the "meanings" of his words. There is some experimental evidence to support the position that children have developed competence with the use of their language in its spoken form by the time they enter first grade. Ervin and Miller (1963), Irwin (1960), Leopold (1949) and others have shown that the full inventory of phonetic units is reasonably complete by the age at which reading instruction begins. Berko (1958) has reported that the child of six has considerable mastery of really important morphological constructions within his language. These studies seem to demonstrate that a child by the age of six does have oral mastery of the basic sound elements of words. From this kind of evidence, Fries may have inferred that the child has developed oral control over "meaning" elements of words. Because Fries is convinced a child has oral control of "meaning," he believes that there is no need in the early stages of reading to emphasize "meaning" supports such as picture and context cues. The child's attention according to Fries should center upon making firm connections between the sequences of individual letters and the words he already has in his speaking vocabulary. Therefore, Fries (1963) has asserted that concern about pictures and the content in the sentences or in the successive sentences making up a story is "extraneous."

Fries' position here may be somewhat supported by the work of Samuels (1967) who found that a picture cue may miscue and may divert attention from the printed page. His experimental evidence showed that his no-picture groups made significantly more correct responses on test trials. Further, his concern about content in sentences as being extraneous could possibly be supported by the work of Seibert (1930) who found that the context seemed to inhibit performance rather than aid performance. It may also be supported by the work of Crothers and Suppes (1967) who found those in the word group excelled in the test situations over those in the sentence group.

Bloomfield and Barnhart (1961) have claimed that the child has so difficult a time forming the connections between visual marks (letters) and speech sounds that he should not be required to add new knowledge. He has urged that the child concentrate on short words in which the letters have a uniform value.

Research evidence to support this position is limited at this point in time.

The preceding discussion indicates there is mixed evidence regarding the use of minimal and maximal contrast word lists in the acquisition of initial reading vocabulary. There is also contradictory evidence in the support for the use of picture cues, context cues, or the concentration on the word itself.

The questions being asked in this study concern the relative performance of beginning readers on: 1) minimal contrast word lists using the word only versus maximal contrast word lists using the word only,

2) minimal contrast word lists using picture cues versus maximal contrast word lists using picture cues, and 3) minimal contrast word lists using context cues versus maximal contrast word lists using context cues.

CHAPTER II

Design of the Experiment

Subjects

An experimental population was desired that had no formal reading instruction and would represent a wide range of ability. On this basis two schools were chosen from the Ravenswood City School District where no formal reading instruction is given in the kindergarten. The experiment was conducted during the first weeks of school while the children were receiving only reading readiness in their classroom instructional program. The two schools chosen were considered by the school district administration to represent the district. One school was a lower middle class school made up of largely Caucasian children and the other was in a deprived area and made up largely of Negro children.

All first-grade children in the two schools were included in the sample. There were 137 children in the first grades and 127 children completed the experiment. The Murphy-Durrell Reading Readiness Test scores for each child in the sample were collected. The children were divided into high and low ability groups within each treatment according to the test scores. A stratified random assignment procedure was used based on sex, school, ability grouping, and class membership. For example, boys in a given class and ability group were randomly assigned to the six treatments. Boys and girls from each school, class, and ability group were represented in each treatment group. Because of the inequality of numbers of children from each school and class an attempt was made to assign proportionally numbers of children from each room to each treatment group and where this was not possible, an attempt was made to assign proportionally to treatment groups by school.

No subject received more than one treatment. Once a subject was assigned to a treatment group he remained with that group until the experiment was completed. There were no replacements added to the original sample. The subjects who did not complete the experiment because of illness or removal from the district were dropped from the sample.

Stimulus Material

The experiment was designed to compare children's word learning on minimal and maximal contrast word lists with the following cues: 1) a graphic stimulus alone, 2) a picture cue with a graphic stimulus, and 3) a context (sentence) cue with a graphic stimulus.

Table 1 indicates the six methods which were used in this study for the word learning task.

The stimulus material consisted of four minimal contrast lists and four maximal contrast lists. The words from each minimal contrast list were randomly assigned to one of the maximal contrast lists. A complete set of the word lists may be found in Appendix A.

There is no evidence available to provide information on the optimal list length for young children. The decision to use four words as an appropriate list length was based on the investigator's experience teaching young children.

The following criteria were used in word selection: 1) they must be monosyllabic, 2) they must pattern in groups of four, 3) they must be nouns, and 4) they should appear in the Kolson (1960) list and/or

Table 1.

The Six Treatments Used in the Word Learning Task

Minimal Contrast Lists	Maximal Contrast Lists
Treatment 1	Treatment 4
Graphic stimulus only	Graphic stimulus only
Treatment 2	Treatment 5
Picture cue plus graphic stimulus	Picture cue plus graphic stimulus
Treatment 3	Treatment 6
Context cue plus graphic stimulus	Context cue plus graphic stimulus

the Rainbow Dictionary (1959). An independent judgment based on the preceding criteria for the words selected was made by a qualified linguist.

The minimal contrasts used were based on varying the initial consonant or the initial consonant cluster, holding the final elements of the word constant. This form is advocated by such linguists as Fries and Bloomfield to teach the consistencies of the language.

Each list contains four words in minimal contrast. As an illustration, the words ten, hen, men, pen, form one list. The final part of the word (en) was held constant and initial elements changed.

To avoid problems of interference from differences in form class, the noun was employed in all lists. Dukes and Bastian (1966) and other investigators have reported that words signifying something concrete were more efficiently learned than those with abstract referents.

The Kolson list (1960) was used as a criterion of the availability of the word in the speech repertoire of the children. This criterion was also used because of the emphasis placed on the importance of the early reading material being meaningful to the child. Carroll (1964) states: "There is evidence that the teaching of the mechanics of speech reconstruction (techniques of word recognition) is best done with material that is meaningful to the learner..." Fries (1963) also points out "learning to read one's native language is learning to transfer, from the auditory signs of the language signals, which the child has already learned, to the visual or the graphic signs of the same signals." Fries, therefore, infers that for the child to make an effective transfer the material should be known to the child.

The pictorial material used was a simple colored picture of the object identified with the noun. The pictorial material for the whole list was drawn by the same artist using the same style to keep the material consistent.

The sentence material made a statement referring to the same object used in the pictorial material. As a further check that the meaning was known to the children the Rainbow Dictionary (1959) was used as a guide. The use of each word in a picture and the content of the context was one of the meanings for the words stated in the Rainbow Dictionary (1959).

The pictorial material and the sentence material may be found in Appendix B.

Method of Presentation

A pilot study was completed to test the procedures used in this experiment. The pilot study was conducted with a population similar to the one used in the study, and thus indicated the procedures for this study were feasible.

Each subject in each treatment group received a study trial, a test trial, a study trial, a test trial, a study trial, a test trial, etc., until he had received ten study and test trials on each word list. Each subject received one list per day for four days. The pilot study investigated the number of study and test trials which would provide the greatest retention on each test. The study indicated that even though some subjects appeared to be able to pronounce all of the words on the list after as few as three study and test trials, those who went through ten study and test trials performed better on the tests.

Therefore, the decision was made to give each subject ten study and ten test trials on each list of words.

To guard against positional effects in the learning situation the order of the words in the list for each study and test trial was randomized.

A study trial consisted of an introductory statement calling attention to the likenesses and differences of the words to be studied. The introduction for the minimal contrast list was: "Here is a list of words. The words all end the same way. The words rhyme. Look at the words." The introduction for the maximal contrast list was: "Here is a list of words. They do not look alike. Look at the words." The child saw the list of four words. The words were then presented one at a time with the proper stimulus for the treatment.

The study trial for graphic stimulus only consisted of showing the subject a card with the word on it. The following directions were given: "This word is hen. Look at the word hen. (The experimenter points to the word.) Say the word hen."

The study trial for the picture cue treatment consisted of showing the subject a card with the picture and the word on it. The following instructions were given: "This is the picture of a hen. Look at the word hen. (The experimenter points to the word.) Say the word hen."

The study trial for the context (sentence) cue treatment consisted of showing the subject a card with a word on it. The following instructions were given: "The hen is in the barnyard. Look at the word hen. (The experimenter points to the word.) Say the word hen."

The test trials for each treatment were the same. The experimenter displayed a card with the word on it. The subject was requested to pronounce the word. There was no feedback on the test trials. The standard directions for the study and test trials for each treatment are presented in Appendix C.

The ten study and test trials were presented on one day. Twenty-four hours later the subject received a test on the words learned the previous day. For this test the experimenter presented a card with a word on it and asked the subject to say the word. There was no correction on this test. Five days after the subject had completed all four lists he received a posttest over the total list. The test procedure was the same as that used for the twenty-four hour test. Each subject was given the total list twice. A copy of the posttest is presented in Appendix D.

Transfer at the early stages of learning has been examined by some investigators. For example, Silberman's (1964) results indicated generalizations are not made from exposure to minimal contrast lists in the learning situation. He implied that generalizations must be taught. Further, Silberman indicated that generalizations need to be made over an extended period of time to facilitate transfer. From experience in teaching young children this investigator would judge that during the initial stages of reading instruction the first-grade child's ability to make generalizations which would facilitate transfer is limited. Other investigators, such as Levin, Baum and Bostwick (1963), concluded that minimal contrast lists facilitated transfer learning faster than maximal contrast lists.

Therefore, a transfer test was designed to evaluate possible transfer in this initial learning situation. The transfer test consists of four real words and four nonsense words. The real words and the nonsense words follow the basic patterns used in the minimal contrast list as well as the initial elements used in the list. In other words, no new elements were introduced. A copy of the test may be found in Appendix E.

The transfer test was given to each subject 24 hours after he had completed the learning sessions on all four lists. For this test the experimenter presented a card with the word on it and asked the subject to say the word. Each subject had three trials on the list.

To review the sequence of events for the experiment the following listing presents the sequence of events for one subject.

Day 1.	Study and test trials for list 1
Day 2.	Twenty-four hour test on list 1
	Study and test trials for list 2
Day 3.	Twenty-four hour test on list 2
	Study and test trials for list 3
Day 4.	Twenty-four hour test on list 3
	Study and test trials for list 4
Day 5.	Twenty-four hour test on list 4
	Transfer test
Day 10.	Posttest

The word lists were presented randomly. For example, on day one, one subject may have had list one and another subject may have had list four, etc. Since more than one experimenter was used, the experimenters were randomly assigned over treatments so that each experimenter presented all six treatments.

Scoring

Each subject in each treatment group was requested to pronounce the word presented to him on the learning test trials, on the twenty-four hour test, on the posttest, and on the transfer test. Each response was scored as correct or incorrect. Each incorrect response was scored according to type of error. The types of errors considered were: 1) initial unit error, 2) final unit error, 3) total error, and 4) omission error.

An initial unit was defined as the initial consonant or initial consonant cluster of a word. The substitution of one consonant or consonant cluster for another was scored as an initial unit error. For example, if the word presented to the subject was hen and he pronounced ten, the error was scored as an initial unit error.

A final unit was defined as the final elements of the words which are held constant in the minimal contrast lists. For example, if the word presented to the subject was rake and he pronounced ring, the error was scored as a final unit error.

An error was scored as a total error if no part of the word presented to the subject was represented in the pronunciation of the word produced by the subject. For example, if the word presented to the subject was lake and he pronounced ring, the error was scored as a total error.

An error was scored as an omission when the subject gave no response to the word presented to him.

Analysis

The experiment was designed in such a manner that an analysis of variance would be an appropriate analysis for the data.

Two types of analyses were made on the data: 1) an analysis of the correct responses given on each test, and 2) an analysis of the four types of errors made on each test.

The analysis of the correct answers was made to compare sources of variation in the performance of the subjects on each test. Each test was analyzed separately to determine if the pattern of performance would be consistent on all tests.

The analysis of the four error types was made for each error type on each test. The separate analysis was made again to determine what, if any, differences in the sources of variation in performance would be evident on the different error types and tests.

The data were analyzed using a four-way fixed effects fully crossed analysis of variance. There were three levels of cue, and two levels each of list type, sex and ability grouping. Thus, there were twenty-four cells ($3 \times 2 \times 2 \times 2 = 24$). In other words, there were four main effect sources of variation plus the corresponding interactions made up of the four main effect sources of variation. Each cell in the analysis contained different subjects.

Subjects were assigned to each treatment by a stratified random assignment procedure which was discussed in detail in the first part of this chapter. Because of unequal numbers in each strata of the sample and because of drop-out due to absence during the experiment, there were an unequal number of subjects in each cell. This represents a departure from the usual analysis of variance assumptions, but a minor one since there were multiple subjects in each cell. To account for the unequal membership in the cells the sums of squares for the analysis of variance were calculated, using a general linear hypothesis (Biomedical Computer Program BMDOSV). This program provides for unequal cell sizes in computation.

A potentially more serious departure from the analysis of variance assumptions concerns the occasional radical inequalities of variance in the cells. The cases of this occurred only when the means were also widely different. A nominal significance level of .0001 or .001 in these cases may be somewhat misleading because of the radical inequalities of variance, but the differences were large enough that it was still clear there were significant differences.

Since this is a fixed-effects analysis, the statistical generalizations possible on the basis of this analysis on the ability grouping cannot be generalized to other ability levels.

CHAPTER III

Results of the Correct Answer Analyses

The data for the learning test trials, the twenty-four hour test, the posttest, and the transfer test were analyzed separately under a four-way fixed effect fully crossed analysis of variance (by list type, by cue characteristic, by sex, by high and low ability grouping) for which a general linear hypothesis was used.

Learning Test Trials

Main Effects. The mean number of correct responses for the main effects of minimal and maximal contrast list types, cue characteristic, sex, and high and low ability grouping are presented in Tables 2a, 2b, 2c, and 2d. The complete analysis of variance table is shown in Table 3. Although there were small differences in achievement between minimal and maximal contrast list types, between cue characteristics, and between boys and girls, the differences were not significant. The differences in achievement between subjects in the high and low ability groups were significant ($F = 55.45$, $p < .0001$). The high ability group made more correct answers than the low ability group.

To further demonstrate the differences in performance between the high and low ability groups Figures 1a, 1b, 1c, 1d, 1e and 1f show the daily learning curves based on the mean proportion of correct responses on each learning test trial for the high and low ability groups on each treatment. The differences in performance on the learning trial tests between the high and low ability groups were consistent.

Table 2a.

Mean Number of Correct Responses on Minimal and Maximal Contrast List Types for the Learning Test Trials

Minimal Contrast Lists Mean	S.D.	Maximal Contrast Lists Mean	S.D.
109.54	38.79	116.05	38.55

Table 2b.

Mean Number of Correct Responses on Each Cue Type for the Learning Test Trials

Graphic Stimulus Only		Graphic Stimulus Plus Picture Cue		Graphic Stimulus Plus Context Cue	
Mean	S.D.	Mean	S.D.	Mean	S.D.
117.66	33.15	110.55	42.61	110.45	37.63

Table 2c.

Mean Number of Correct Responses Made by Boys and Girls for the Learning Test Trials

Boys		Girls	
Mean	S.D.	Mean	S.D.
112.94	27.72	112.71	37.93

Table 2d.

Mean Number of Correct Responses Made by the High and Low Ability Groups for the Learning Test Trials

High		Low	
Mean	S.D.	Mean	S.D.
133.17	26.66	92.14	35.09

Table 3.
Analysis of Variance for the Learning Test Trials

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	1344.00	1344.00			
Cue	2	1297.00	648.50			
High-Low	1	53479.00	53479.00	55.45	1/103	p < .0001
Sex	1	3.00	3.00			
List Type × Cue	2	8722.00	4361.00	4.52	2/103	p < .025
List Type × High-Low	1	735.00	735.00			
List Type × Sex	1	208.00	208.00			
Cue × High-Low	2	1977.00	988.50			
Cue × Sex	2	640.00	320.00			
High-Low × Sex	1	262.00	262.00			
List Type × Cue × High-Low	2	1012.00	506.00			
List Type × Cue × Sex	2	3483.00	1741.50			
List Type × High-Low × Sex	1	3057.00	3057.00	3.17	1/103	p > .05
Cue × High-Low × Sex	2	144.00	72.00			
List Type × Cue × High-Low × Sex	2	58.00	29.00			
Residual	103	99342.00				
Total	126	175763.00				

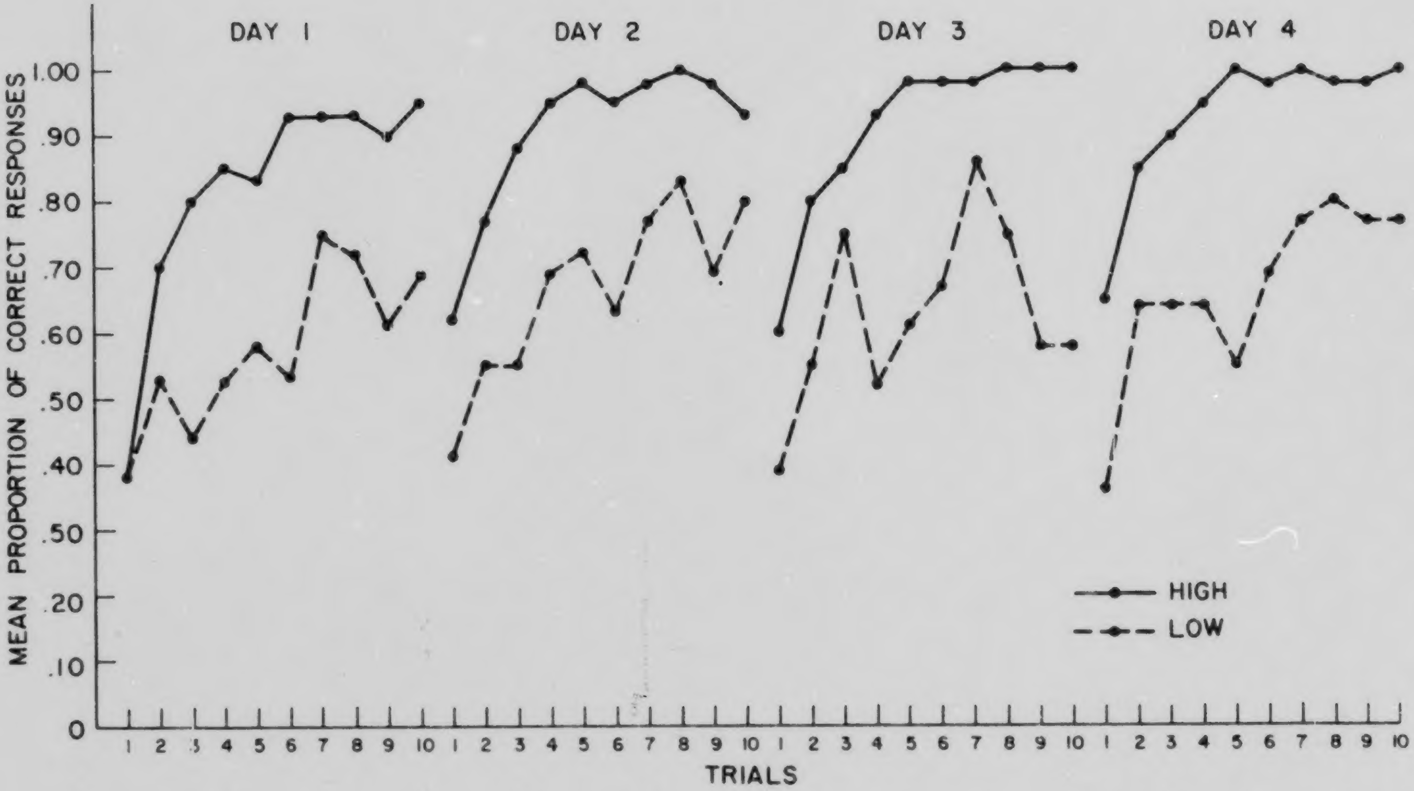


Figure 1a. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the High and Low Ability Groups on the Graphic Stimulus Only with Minimal Contrast Lists.

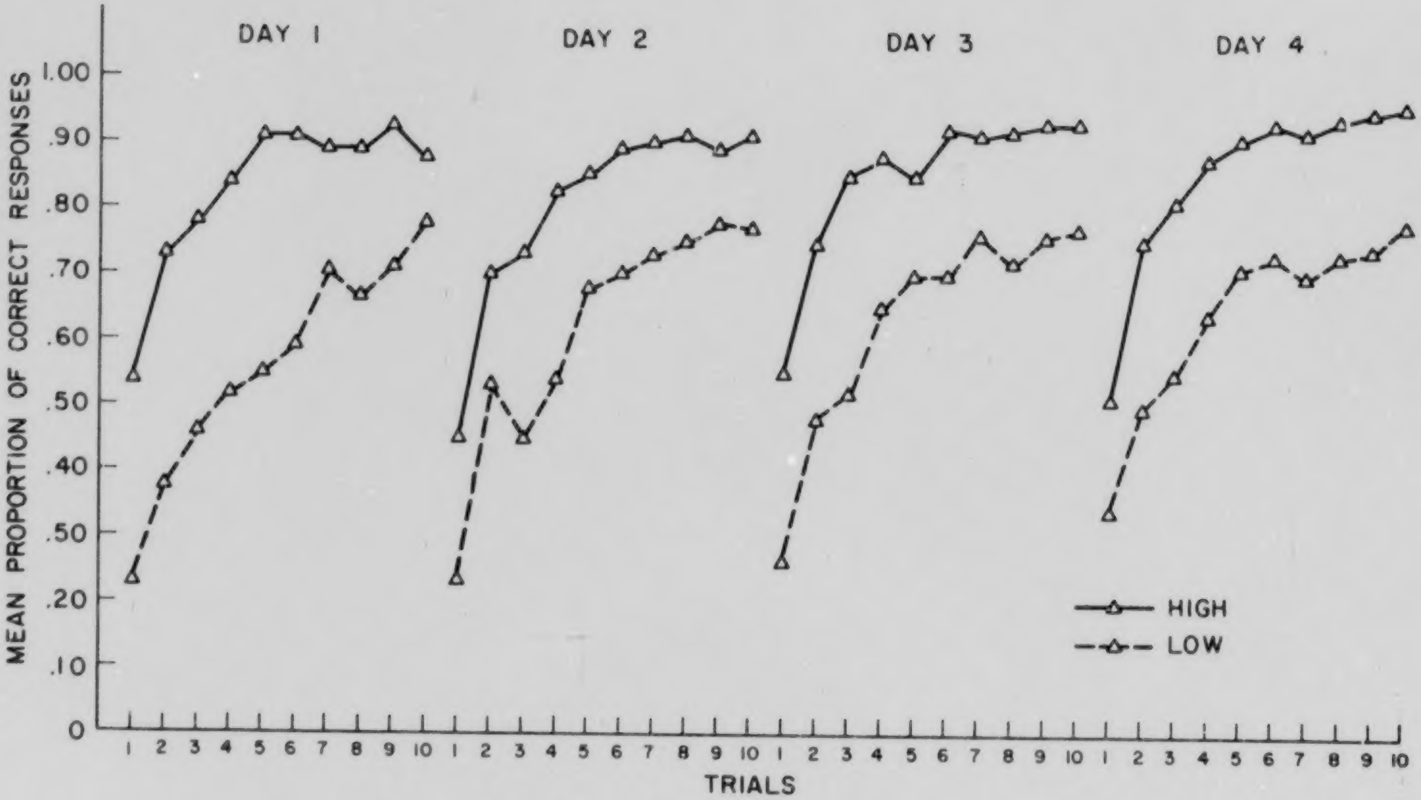


Figure 1b. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the High and Low Ability Groups on the Graphic Stimulus Only with Maximal Contrast Lists.

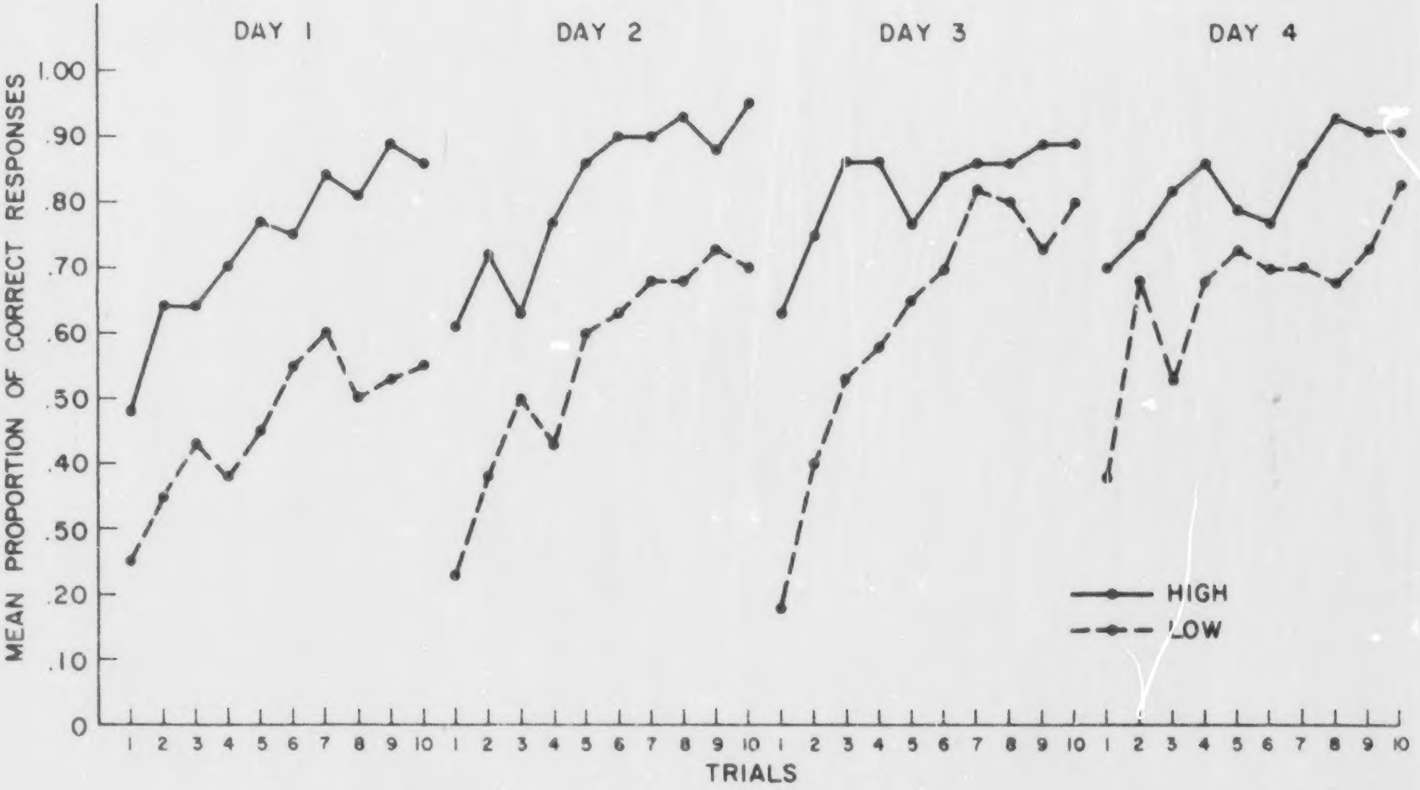


Figure 1c. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the High and Low Ability Groups on the Graphic Stimulus Plus a Picture Cue with Minimal Contrast Lists.

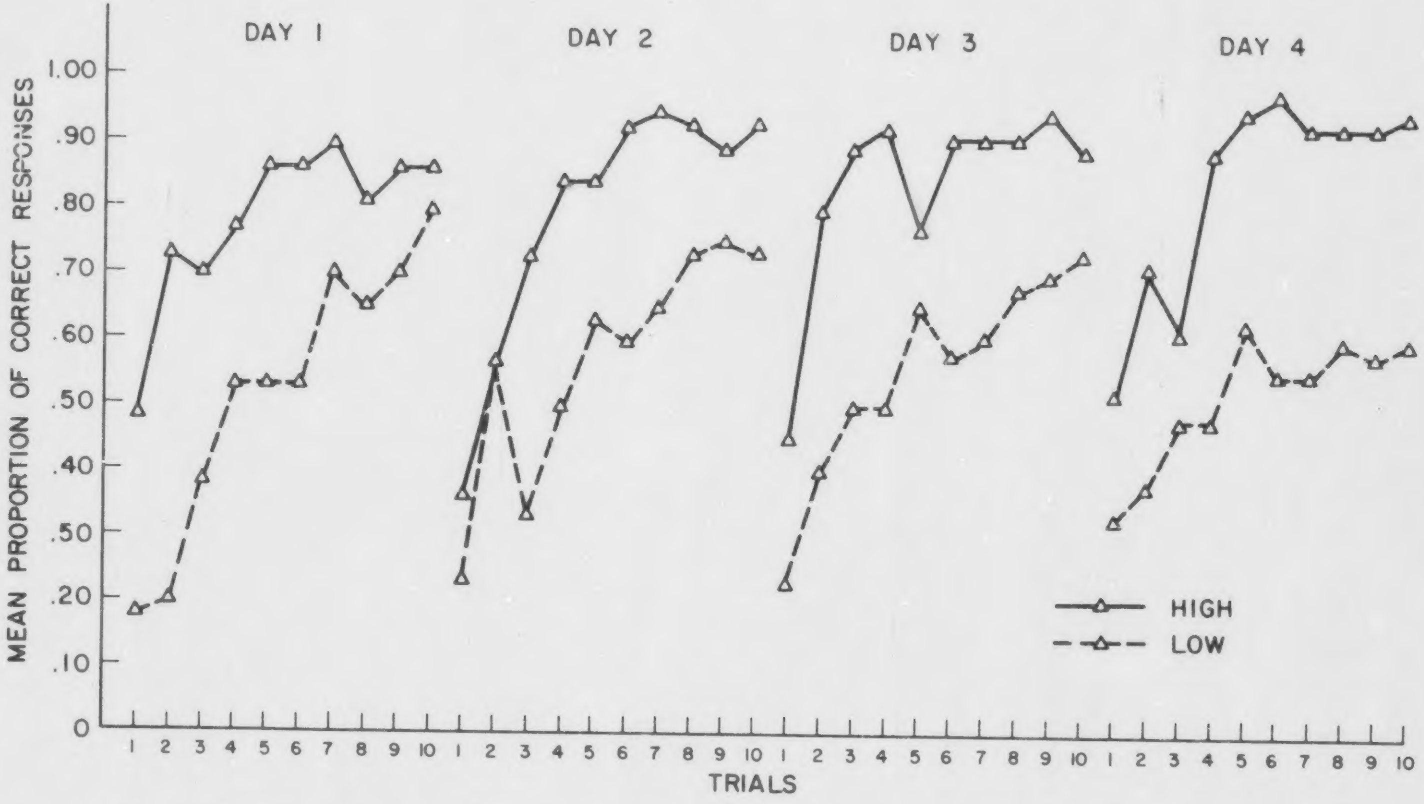


Figure 1d. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the High and Low Ability Groups on the Graphic Stimulus Plus a Picture Cue with Maximal Contrast Lists.

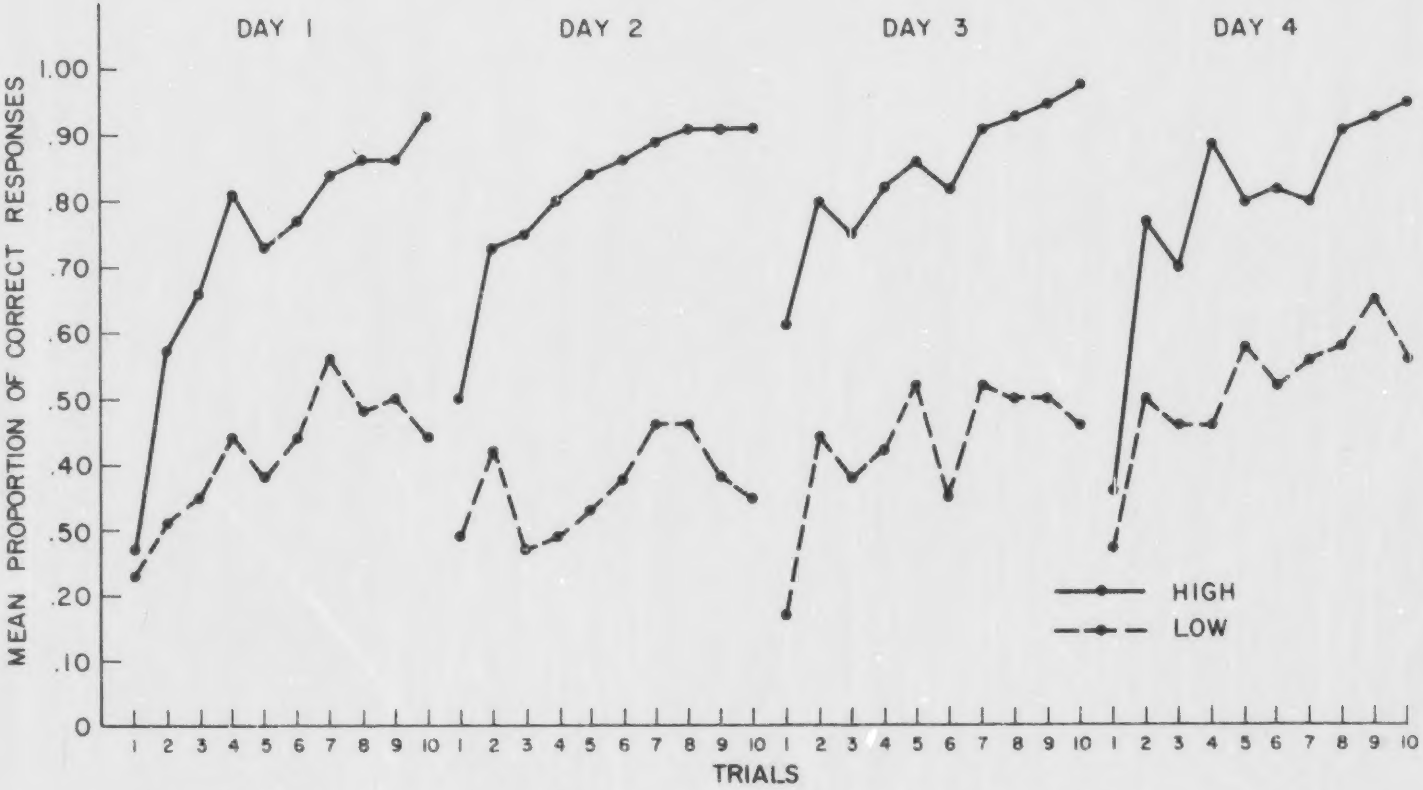


Figure 1e. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the High and Low Ability Groups on the Graphic Stimulus Plus a Context Cue with Minimal Contrast Lists.

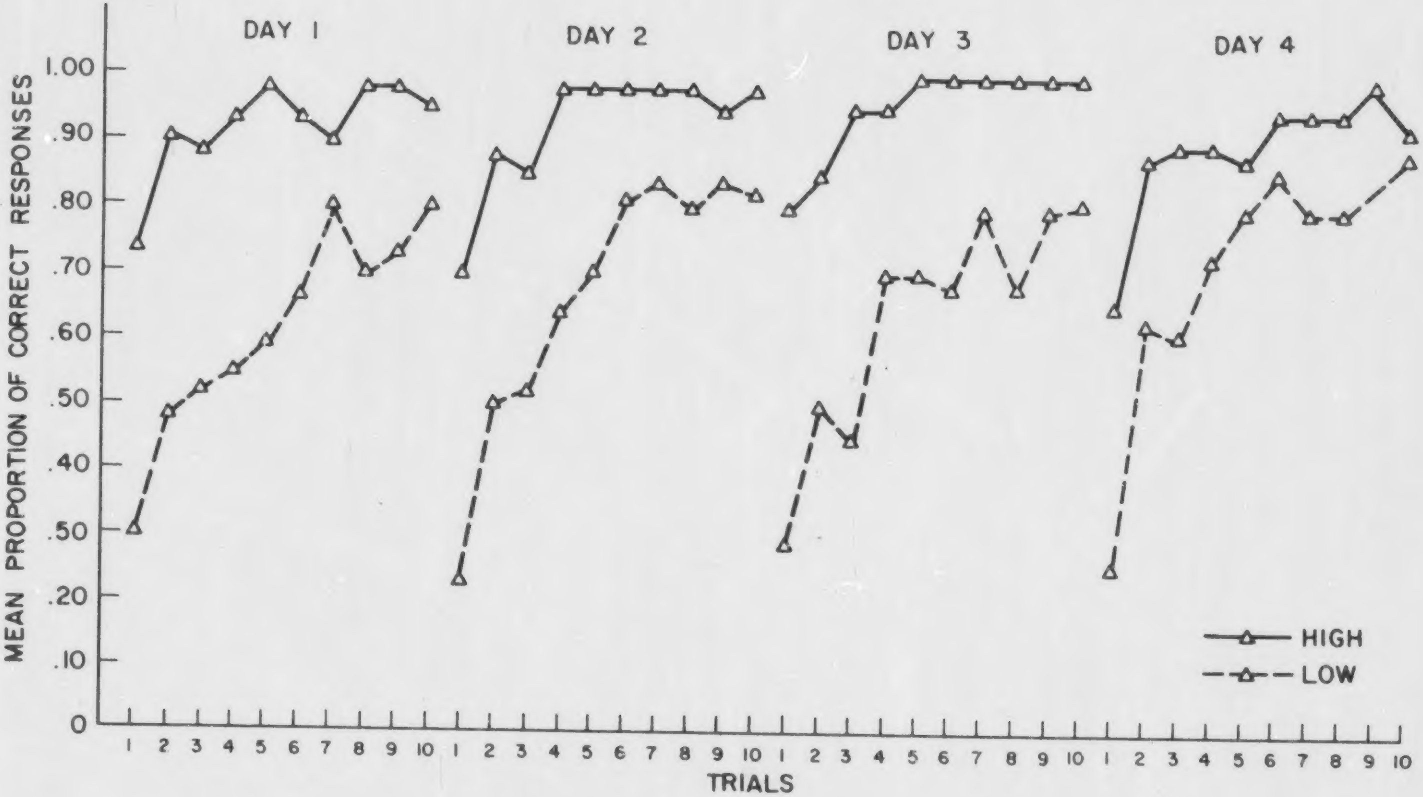


Figure 1f. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the High and Low Ability Groups on the Graphic Stimulus Plus a Context Cue with Maximal Contrast Lists.

Interactions. Of the possible two-way interactions only the interaction of minimal and maximal contrast list types and cue was significant ($F = 4.52$, $p < .025$). Table 4 presents the mean number of correct responses for each treatment to show the differences in performance for each cue and list type. Figure 2 shows the effect of the interaction. The effect of the interaction was that when a graphic stimulus only was presented during the study trials it was most successful with a minimal contrast list and when a graphic stimulus plus a context cue was presented during the study trials it was most successful with a maximal contrast list. Furthermore, when a graphic stimulus plus a context cue was presented during the study trials with a minimal contrast list it had a depressing effect on performance. When a graphic stimulus plus a picture cue was presented during the study trials, the performance of the subjects on the learning test trials was nearly equal when this cue was used with either minimal or maximal contrast lists.

To be more explicit about the components of the interaction shown above the performance on the learning test trials by cue characteristic, the daily learning curves for each cue and list type are compared in Figures 3a, 3b, and 3c. Figure 3a presents the proportion of correct responses on each learning test trial on each day when a graphic stimulus only was presented for the study trials with minimal and maximal contrast list types. The performance on the minimal contrast lists was generally slightly higher than the performance on maximal contrast lists. Although the daily differences were small, the overall differences were sufficient to produce a significant interaction. Figure 3b presents the proportion of correct responses on each learning test trial when a graphic

Table 4.

Mean Number of Correct Responses for Each List Type and Cue for the Learning Test Trials

Cue	Minimal Contrast Lists		Maximal Contrast Lists	
	Mean	S.D.	Mean	S.D.
Graphic Stimulus only	123.58	33.56	112.55	32.73
Graphic Stimulus plus Picture Cue	110.81	37.84	110.29	40.98
Graphic Stimulus plus Context Cue	96.78	40.94	125.48	27.15

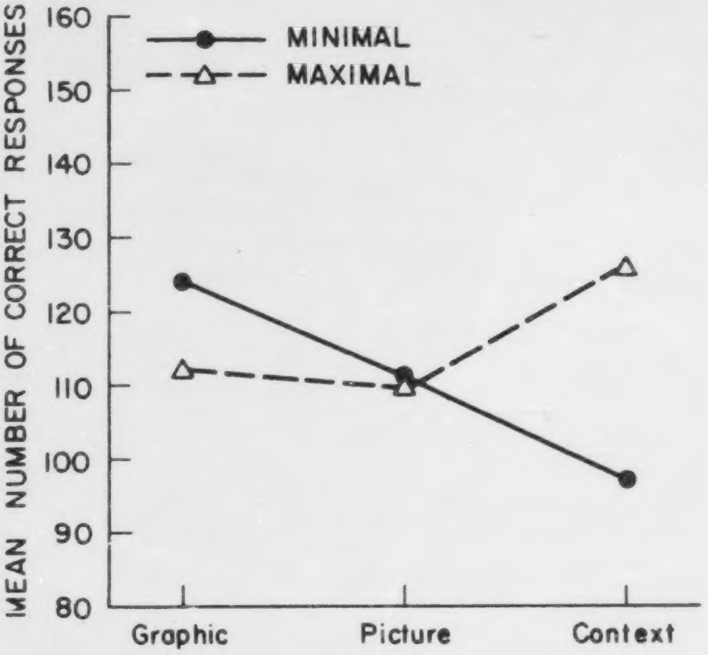


Figure 2. Learning Test Trials: Mean Number of Correct Responses on Each List Type and Cue Type.

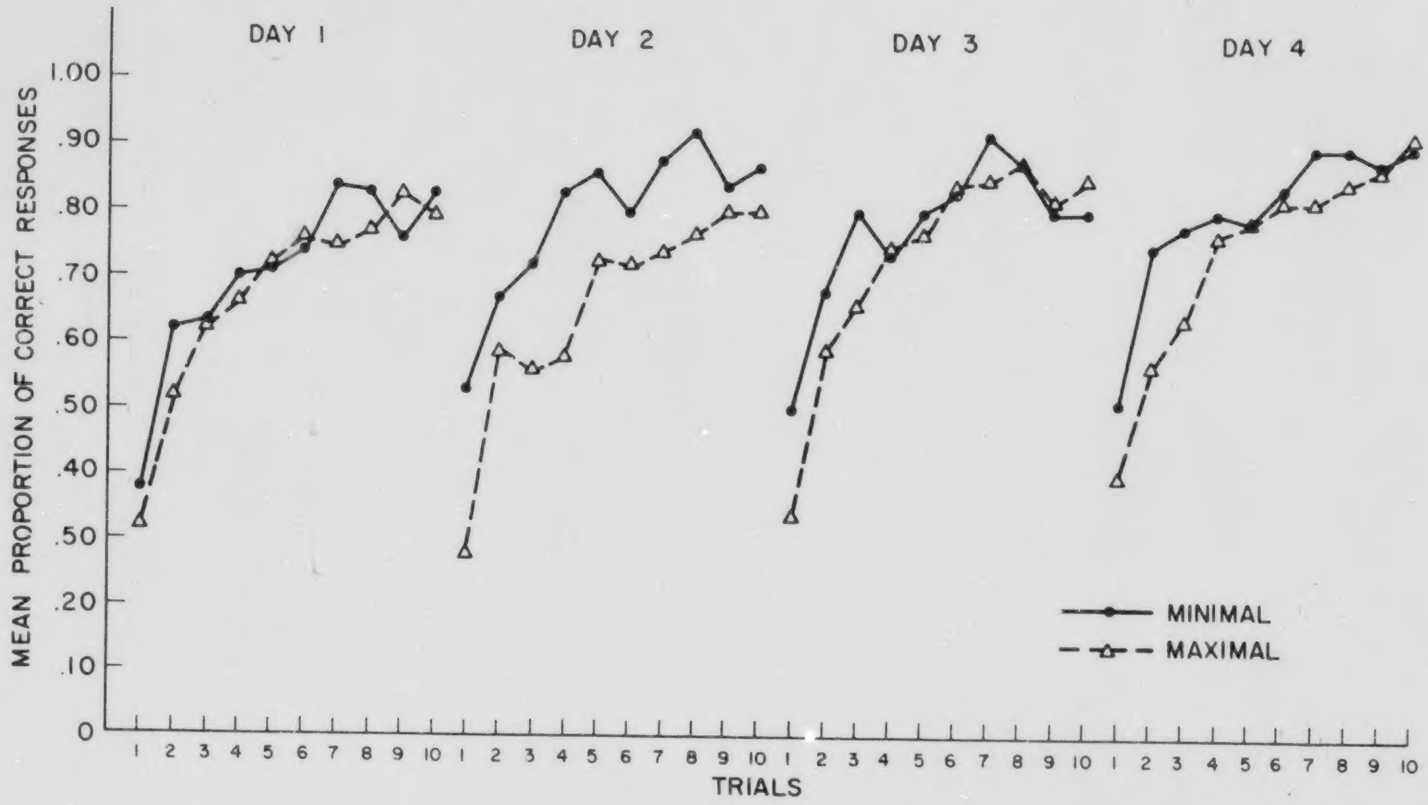


Figure 3a. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the Graphic Stimulus Only with Minimal and Maximal Contrast Lists.

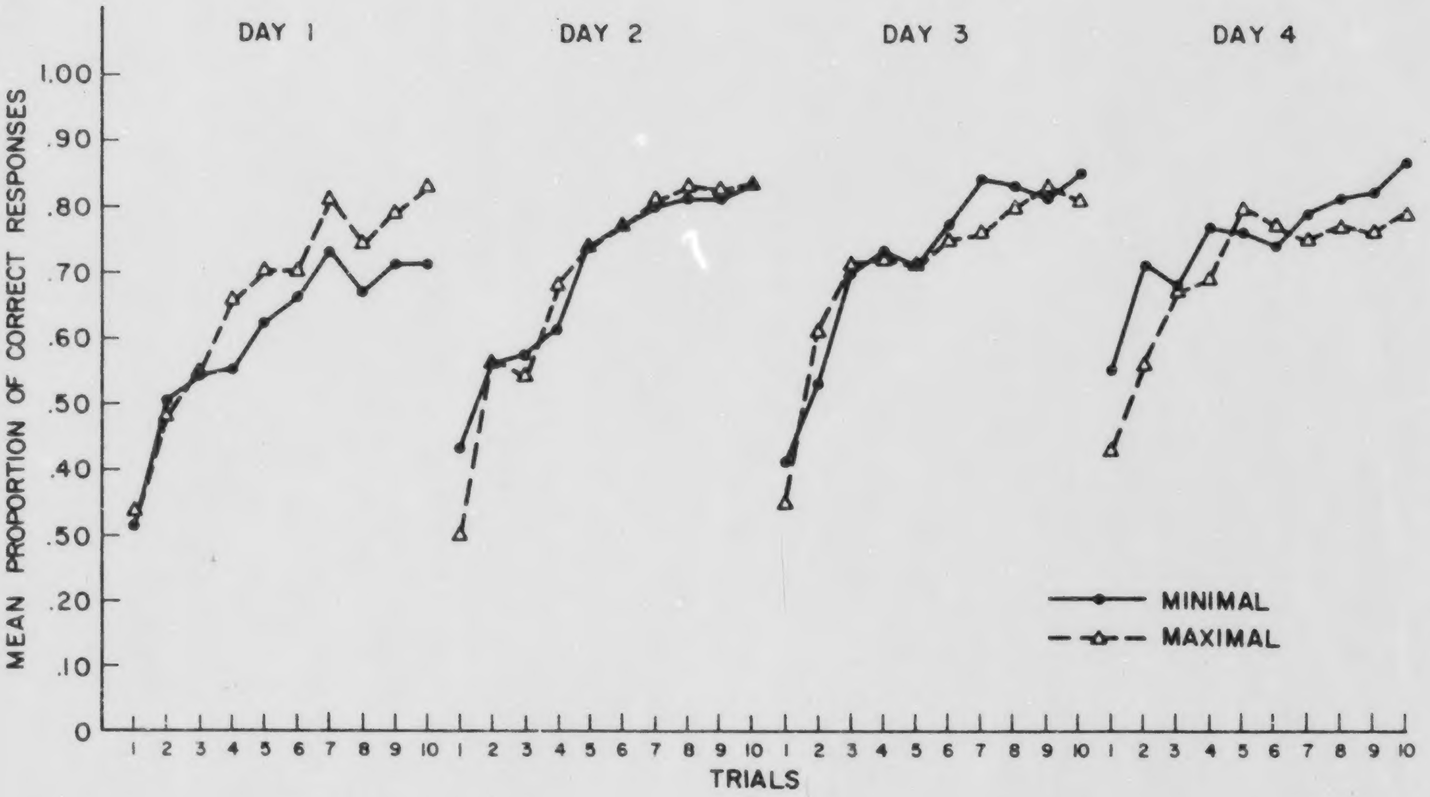


Figure 3b. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the Graphic Stimulus Plus a Picture Cue with Minimal and Maximal Contrast Lists.

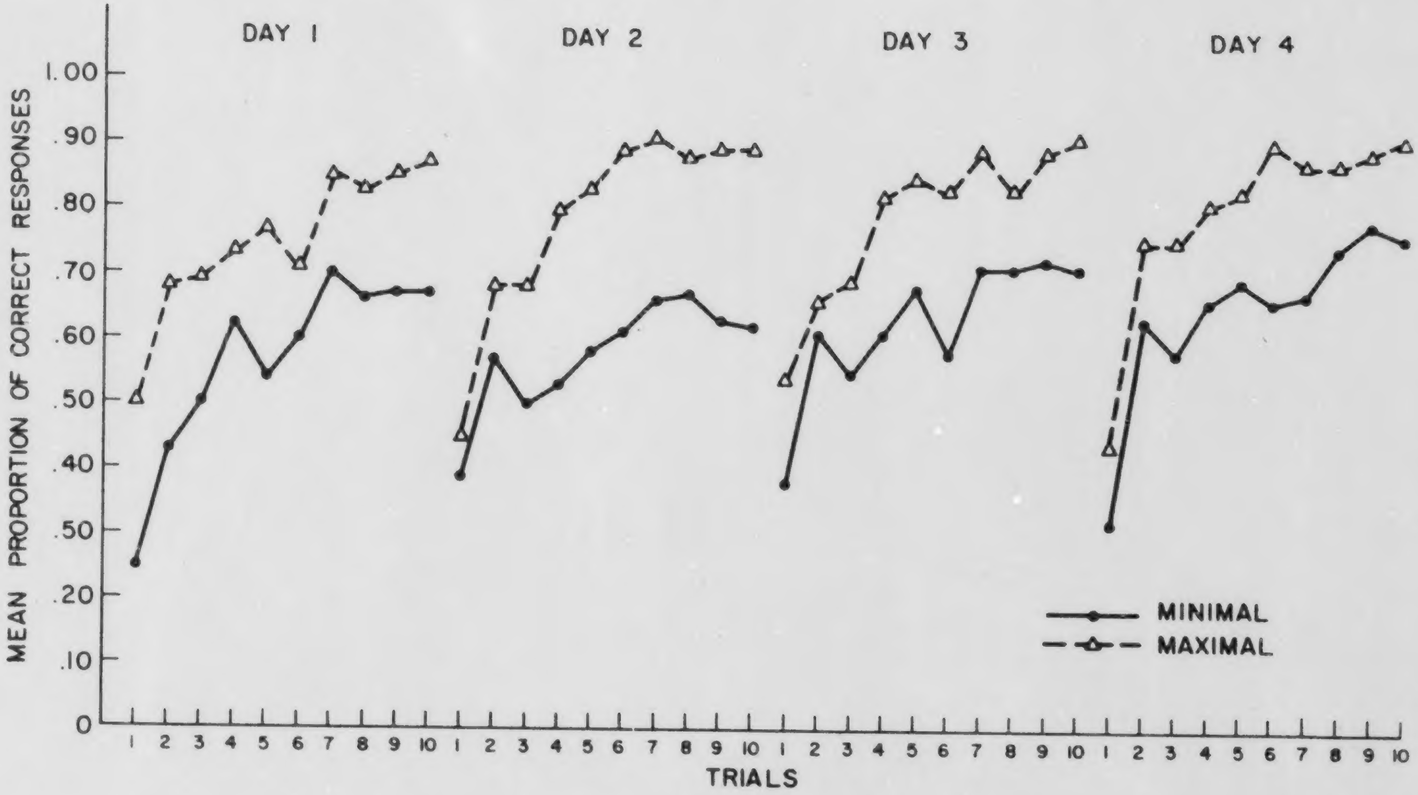


Figure 3c. Learning Test Trials: Mean Proportion of Correct Responses on Each Test Trial by Day for the Graphic Stimulus Plus a Context Cue with Minimal and Maximal Contrast Lists.

stimulus plus a picture cue was presented for each study trial with minimal and maximal contrast lists. The performance with this cue is nearly equal on both minimal and maximal contrast lists. Figure 3c presents the proportion of correct responses on each learning test trial when a graphic stimulus plus a context cue was presented for each study trial with minimal and maximal contrast lists. It is evident the performance of the subjects was better on the maximal contrast lists. The differences in performance on this cue when compared with the other treatments did produce a significant interaction.

The effect of the interaction is shown in another way in Figure 4. This figure presents the mean number of correct responses for each day on the learning test trials for each treatment group. 1) During the study trials the treatments that used a graphic stimulus plus a context cue with maximal contrast lists and a graphic stimulus only with minimal contrast lists have similar performance and produced the highest scores. 2) During the study trials the treatments that used a graphic stimulus only with maximal contrast lists, a graphic stimulus plus a picture cue with minimal contrast lists, and a graphic stimulus plus a picture cue with maximal contrast lists produced similar performance levels that were lower than those listed under number one. 3) During the study trials the treatment that used a graphic stimulus plus a context cue with minimal contrast lists produced a lower performance level than the other treatments listed under numbers one and two.

None of the three-way interactions were significant. However, the interaction of minimal and maximal contrast list types, high and low ability grouping, and sex approached significance (F = 3.17 and an

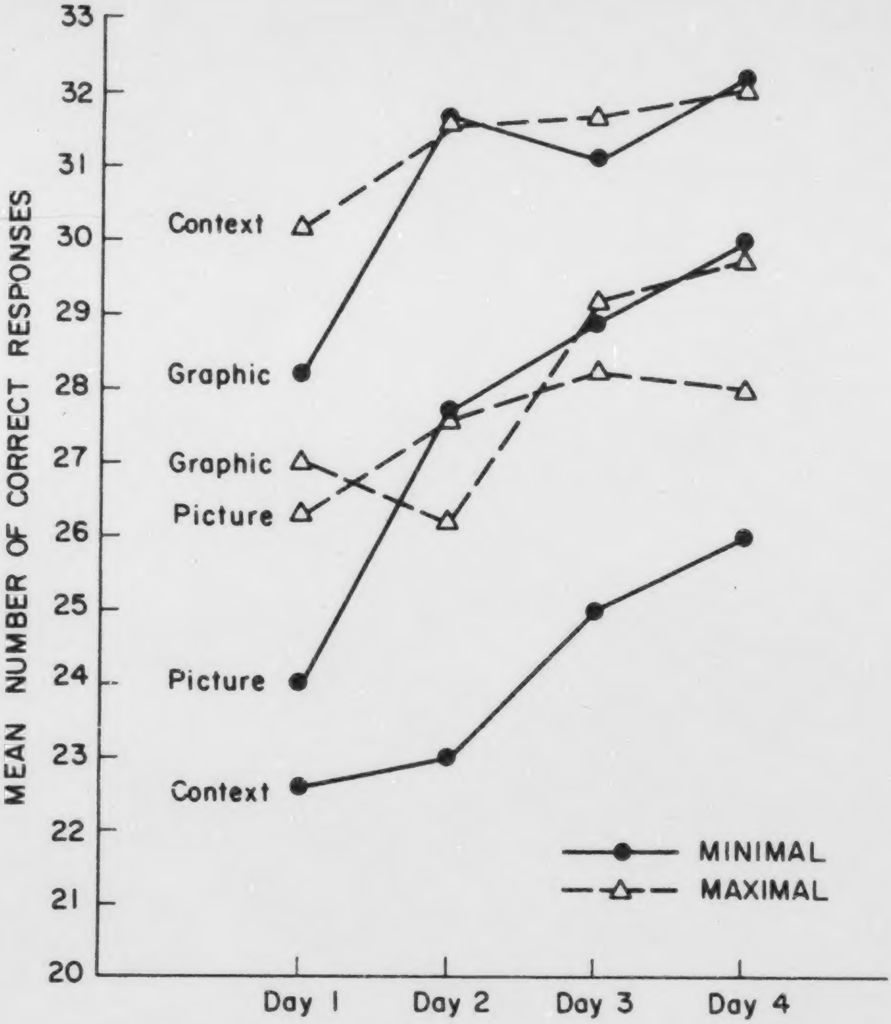


Figure 4. Learning Test Trials: Mean Number of Correct Responses by Day for Each List Type and Cue.

$F = 3.92$ needed for $p = .05$). The pattern found here was similar to that found on the tests to be reported later where this interaction was significant, therefore, it merits attention here. Table 5 presents the mean number of correct responses made by boys and girls in the high and low groups on the minimal and maximal contrast lists. The interaction between list type, grouping, and sex is shown in Figure 5. The boys in the high ability group had higher scores on maximal contrast lists and the girls in the high ability group had higher scores on minimal contrast lists. Both boys and girls in the low ability group had higher scores on maximal contrast lists.

Twenty-four Hour Test

Main Effects. The mean number of correct responses for the main effects of list type, cue, sex, and high and low ability grouping are shown in Tables 6a, 6b, 6c, and 6d. The complete analysis of variance table is shown in Table 7. The differences in performance on the effects of list type, cue, and sex were not significant. The high and low ability grouping was significant ($F = 50.56$, $p < .0001$). The high ability group made more correct responses than the low ability group.

Interactions. Of the possible two-way interactions only the interaction of minimal and maximal contrast list types and cue was significant ($F = 4.98$, $p < .01$). The mean number of correct responses for each treatment group by list type and cue is presented in Table 8. As on the learning test trials, when a graphic stimulus only was used during the learning trials it was most successful with a minimal contrast list and when a graphic stimulus plus a context cue was used during the learning trials it was most successful with a maximal contrast list. When

Table 5.

Mean Number of Correct Responses Made by Boys and Girls in High and Low Ability Groups on Minimal and Maximal Contrast List Types for the Learning Test Trials

List Type	Sex	High Mean	High S.D.	Low Mean	Low S.D.
Minimal Contrast Lists	Boys	130.42	25.33	86.27	36.19
	Girls	135.46	30.08	85.49	34.74
Maximal Contrast Lists	Boys	140.99	20.04	94.26	33.84
	Girls	127.59	30.70	103.99	51.07

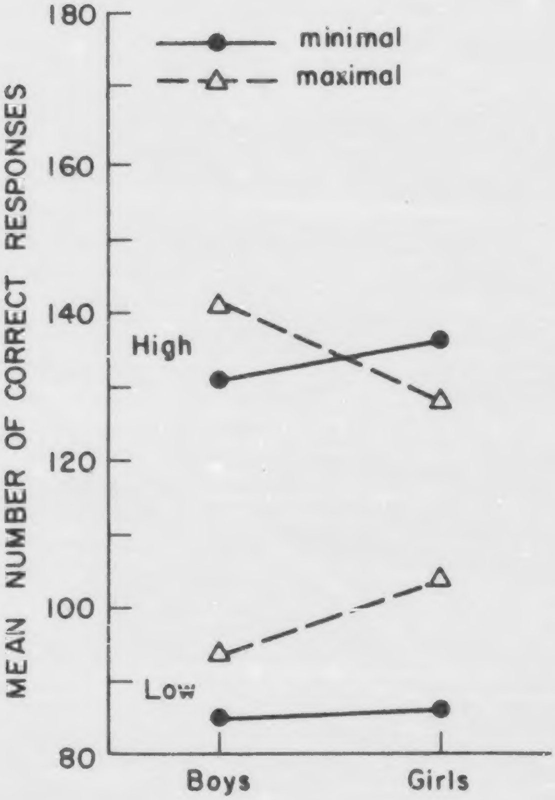


Figure 5. Learning Test Trials: Mean Number of Correct Responses Made by Boys and Girls in the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

Table 6a.

Mean Number of Correct Responses on Minimal and Maximal Contrast List Types for the Twenty-four Hour Test

Minimal Contrast Lists		Maximal Contrast Lists	
Mean	S.D.	Mean	S.D.
9.25	4.81	9.70	3.97

Table 6b.

Mean Number of Correct Responses on Each Cue Type for the Twenty-four Hour Test

Graphic Stimulus Only		Graphic Stimulus Plus Picture Cue		Graphic Stimulus Plus Context Cue	
Mean	S.D.	Mean	S.D.	Mean	S.D.
9.51	4.53	9.71	3.92	9.22	4.78

Table 6c.

Mean Number of Correct Responses Made by Boys and Girls for the Twenty-four Hour Test

Boys		Girls	
Mean	S.D.	Mean	S.D.
9.35	4.27	9.63	4.74

Table 6d.

Mean Number of Correct Responses Made by High and Low Ability Groups for the Twenty-four Hour Test

High		Low	
Mean	S.D.	Mean	S.D.
11.80	3.67	7.13	3.80

Table 7.
Analysis of Variance for the Twenty-four Hour Test

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	6.40	6.40			
Cue	2	4.90	2.45			
High-Low	1	690.02	690.02	50.56	1/103	$p < .0001$
Sex	1	1.67	1.67			
List Type × Cue	2	135.89	67.94	4.98	2/103	$p < .01$
List Type × High-Low	1	23.30	23.30			
List Type × Sex	1	5.77	5.77			
Cue × High-Low	2	32.70	16.35			
Cue × Sex	2	4.57	2.28			
High-Low × Sex	1	2.58	2.58			
List Type × Cue × High-Low	2	30.89	15.44			
List Type × Cue × Sex	2	10.73	5.36			
List Type × High-Low × Sex	1	62.09	62.09	4.55	1/103	$p < .05$
Cue × High-Low × Sex	2	1.59	.79			
List Type × Cue × High-Low × Sex	2	2.79	1.39			
Residual	103	1405.82				
Total	126	2421.71				

Table 8.

Mean Number of Correct Responses for Each List Type and Cue for the Twenty-four Hour Test

Cue	Minimal Contrast Lists		Maximal Contrast Lists	
	Mean	S.D.	Mean	S.D.
Graphic Stimulus only	10.26	5.02	8.86	3.06
Graphic Stimulus plus Picture Cue	10.10	3.96	9.33	3.94
Graphic Stimulus plus Context Cue	7.65	5.11	10.95	3.79

the graphic stimulus plus a picture cue was used during the study trials it produced nearly equal scores with minimal and maximal contrast lists. Figure 6 presents the effect of this interaction.

Of the three-way interactions possible only the interaction of minimal and maximal contrast list types, high and low ability grouping, and sex was significant ($F = 4.55, p < .05$). Table 9 presents the mean number of correct responses made by the boys and girls on the minimal and maximal list types in the high and low ability groups. Figure 7 presents the effect of this interaction. The boys in the high ability group were more successful on maximal contrast lists and girls in the high ability group were more successful on minimal contrast lists. Both boys and girls in the low ability group were more successful on maximal contrast lists.

Posttest

Main Effects. The mean number of correct responses for the effects of minimal and maximal contrast list type, cue, sex, and high and low ability grouping are shown in Tables 10a, 10b, 10c, and 10d. The complete analysis of variance is presented in Table 11. There are slight differences in performance on the list type, cue, and sex but they were not significant. The high and low ability grouping was significant ($F = 55.09, p < .0001$). The high ability group made more correct responses than the low ability group.

Interactions. Only the two-way interaction of minimal and maximal contrast list types and cue was significant ($F = 3.33, p < .05$). The mean number of correct responses for each treatment group on each list type and cue are presented in Table 12. As on the learning test trials

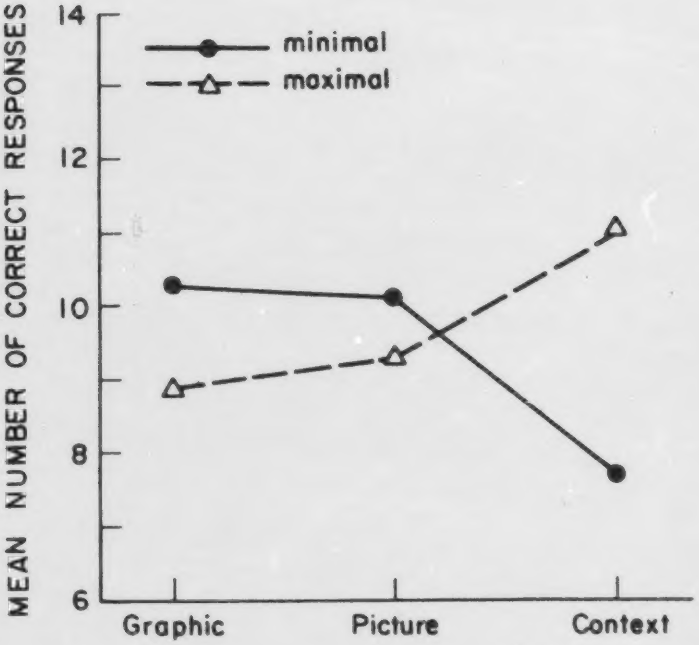


Figure 6. Twenty-four Hour Test: Mean Number of Correct Responses on Each List Type and Cue.

Table 9.

Mean Number of Correct Responses Made by Boys and Girls in High and Low Ability Groups on Minimal and Maximal Contrast Lists for the Twenty-four Hour Test

List Type	Sex	High		Low	
		Mean	S.D.	Mean	S.D.
Minimal Contrast Lists	Boys	11.42	3.39	6.40	4.17
	Girls	12.85	4.03	6.44	4.35
Maximal Contrast Lists	Boys	12.40	2.87	7.21	3.49
	Girls	10.88	4.30	8.69	2.90

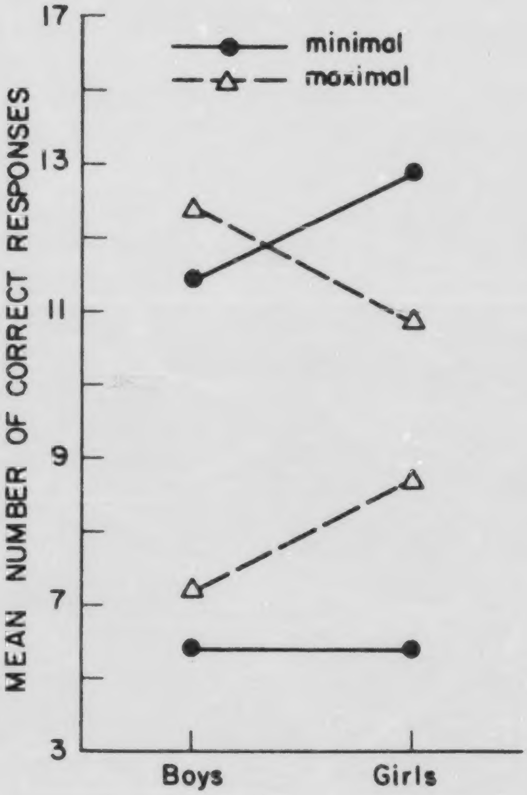


Figure 7. Twenty-four Hour Test: Mean Number of Correct Responses Made by Boys and Girls in the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

Table 10a.

Mean Number of Correct Responses on Minimal and Maximal Contrast List Types for the Posttest

Minimal Contrast Lists		Maximal Contrast Lists	
Mean	S.D.	Mean	S.D.
9.21	7.24	9.42	8.01

Table 10b.

Mean Number of Correct Responses on Each Cue Type for the Posttest

Graphic Stimulus Only		Graphic Stimulus Plus Picture Cue		Graphic Stimulus Plus Context Cue	
Mean	S.D.	Mean	S.D.	Mean	S.D.
8.68	7.37	9.91	7.99	9.34	7.95

Table 10c.

Mean Number of Correct Responses Made by Boys and Girls for the Posttest

Boys		Girls	
Mean	S.D.	Mean	S.D.
8.60	4.84	9.53	7.58

Table 10d.

Mean Number of Correct Responses Made by High and Low Ability Groups for the Posttest

High		Low	
Mean	S.D.	Mean	S.D.
13.42	7.88	5.14	4.85

Table 11.
Analysis of Variance for the Posttest

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	.74	.74			
Cue	2	26.88	13.44			
High-Low	1	2211.38	2211.38	55.09	1/103	$p < .0001$
Sex	1	1.51	1.51			
List Type × Cue	2	267.09	133.54	3.33	2/103	$p < .05$
List Type × High-Low	1	36.31	36.31			
List Type × Sex	1	173.57	173.57	4.32	1/103	$p < .05$
Cue × High-Low	2	37.77	18.88			
Cue × Sex	2	27.66	13.83			
High-Low × Sex	1	23.81	23.81			
List Type × Cue × High-Low	2	30.29	15.14			
List Type × Cue × Sex	2	130.45	65.22			
List Type × High-Low × Sex	1	222.59	222.59	5.54	1/103	$p < .025$
Cue × High-Low × Sex	2	86.57	43.28			
List Type × Cue × High-Low × Sex	2	68.41	34.21			
Residual	103	4134.78				
Total	126	7479.81				

Table 12.

Mean Number of Correct Responses for Each List Type and Cue for the Posttest

Cue	Minimal Contrast Lists		Maximal Contrast Lists	
	Mean	S.D.	Mean	S.D.
Graphic Stimulus only	10.47	6.72	7.14	7.71
Graphic Stimulus plus Picture Cue	9.95	8.69	9.86	7.45
Graphic Stimulus plus Context Cue	7.48	6.95	11.38	8.62

and the twenty-four hour test, when a graphic stimulus only was used during the study trials, it was most successful with a minimal contrast list, and when a graphic stimulus plus a context cue was used during study trials it was most successful with a maximal contrast list. When the graphic stimulus plus a picture cue was used during the study trials it produced nearly equal scores with minimal and maximal contrast lists. The effect of the interaction is presented in Figure 8.

The two-way interaction of minimal and maximal contrast lists and sex was significant ($F = 4.32$, $p < .05$). The mean number of correct responses for boys and girls on minimal and maximal list types are presented in Table 13. The boys made higher scores on maximal contrast lists and girls made higher scores on minimal contrast lists. The effect of this interaction is presented in Figure 9.

The three-way interaction of minimal and maximal contrast list types, high and low ability grouping, and sex was significant ($F = 5.54$, $p < .025$). The mean number of correct responses for boys and girls in high and low ability groups on minimal and maximal contrast lists are presented in Table 14. As on the learning test trials and the twenty-four hour test, the boys in the high ability group made higher scores on maximal contrast lists and girls in the high ability group made higher scores on minimal contrast lists. But unlike the results of the two previous tests where the boys and girls in the low ability group both made higher scores on maximal contrast lists, on the posttest both boys and girls in the low ability group made slightly higher scores on minimal contrast lists. Figure 10 presents the effect of the interaction.

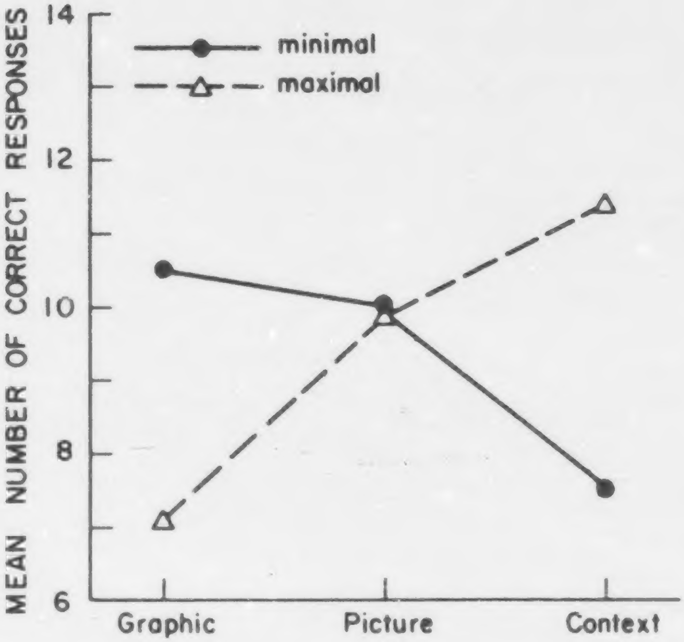


Figure 8. Posttest: Mean Number of Correct Responses on Each List Type and Cue.

Table 13.

Mean Number of Correct Responses Made by Boys and Girls on Minimal and Maximal Contrast List Types for the Posttest

List Type	Boys		Girls	
	Mean	S.D.	Mean	S.D.
Minimal	8.47	19.15	10.07	8.13
Maximal	9.79	9.80	9.00	6.89

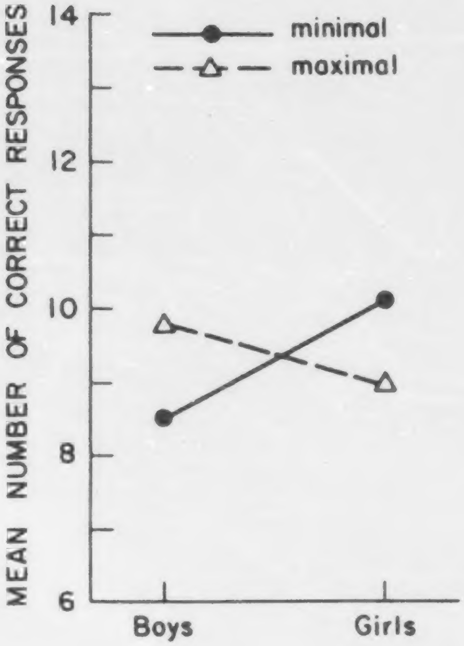


Figure 9. Posttest: Mean Number of Correct Responses Made by Boys and Girls on Minimal and Maximal Contrast Lists.

Table 14.

Mean Number of Correct Responses Made by Boys and Girls in High and Low Ability Groups on Minimal and Maximal Contrast List Types for the Posttest

List Type	Sex	High Mean	High S.D.	Low Mean	Low S.D.
Minimal Contrast Lists	Boys	11.26	7.07	4.93	5.15
	Girls	15.08	7.95	5.99	5.79
Maximal Contrast Lists	Boys	16.80	7.97	4.26	5.01
	Girls	11.59	7.94	5.62	2.96

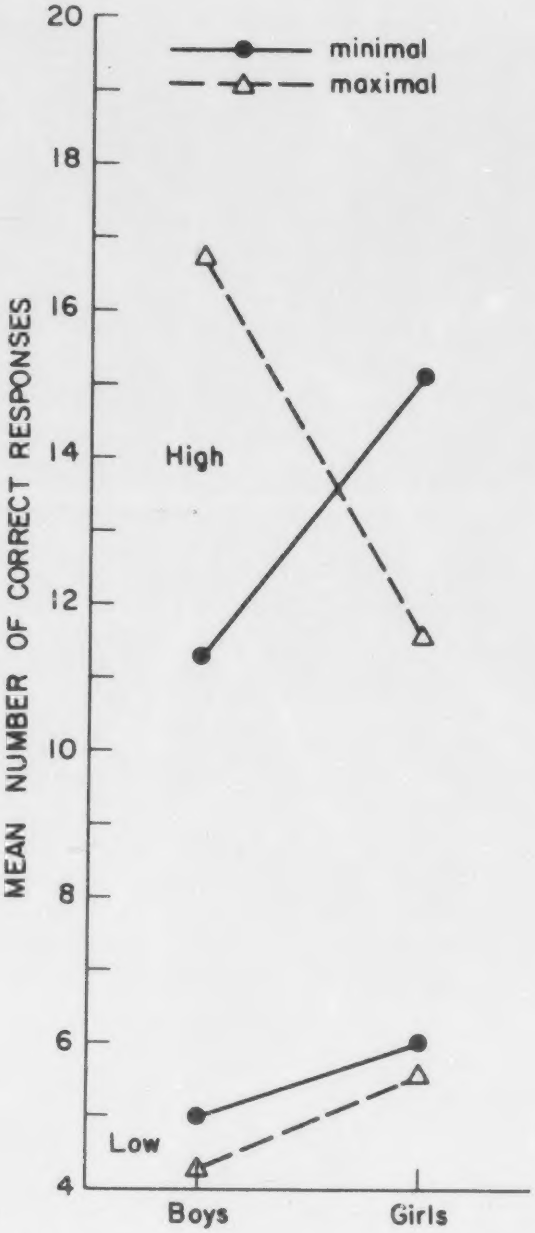


Figure 10. Posttest. Mean Number of Correct Responses Made by Boys and Girls in the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

Transfer Test

Main Effect. The mean number of correct responses for the effects of minimal and maximal contrast list types, cue, sex, and high and low ability grouping are shown in Tables 15a, 15b, 15c, and 15d. The complete analysis of variance table is presented in Table 16. There are slight differences in performance on the effects of list type and sex but the differences are not significant. The effect of cue was significant ($F = 3.23$, $p < .05$). The three sources of cue were compared using t-tests for the scores. Table 15e summarizes the results. The subjects who were presented the graphic stimulus plus a picture cue during the study trials made the highest overall scores. The effect of high and low ability grouping was significant ($F = 14.37$, $p < .001$). The high ability group made more correct responses than the low ability group.

Interactions. Only the two-way interaction of minimal and maximal contrast list types and cue was significant ($F = 3.96$, $p < .025$). The mean number of correct responses for each treatment group are shown in Table 17. When a graphic stimulus only was presented during the study trials it was most successful with a minimal contrast list. When the graphic stimulus plus a picture cue was presented during the study trials it was most successful with a minimal contrast list. This cue combination presented during the study trials and used with a maximal contrast list produced as high scores as did the graphic stimulus only with minimal contrast lists. When a graphic stimulus plus a context cue was used during the study trials it was most successful with maximal contrast lists. The effect of the interaction is presented in Figure 11.

Table 15a.

Mean Number of Correct Responses on Minimal and Maximal Contrast List Types for the Transfer Test

Minimal Contrast Lists		Maximal Contrast Lists	
Mean	S.D.	Mean	S.D.
3.46	4.45	3.33	4.28

Table 15b.

Mean Number of Correct Responses on Each Cue Type for the Transfer Test

Graphic Stimulus Only		Graphic Stimulus Plus Picture Cue		Graphic Stimulus Plus Context Cue	
Mean	S.D.	Mean	S.D.	Mean	S.D.
2.29	2.87	4.50	5.54	3.45	4.29

Table 15c.

Mean Number of Correct Responses Made by Boys and Girls for the Transfer Test

Boys		Girls	
Mean	S.D.	Mean	S.D.
3.62	4.91	3.20	3.59

Table 15d.

Mean Number of Correct Responses Made by High and Low Ability Groups for the Transfer Test

High		Low	
Mean	S.D.	Mean	S.D.
4.75	5.45	2.02	2.12

Table 15e.

T-Tests for the Sources of Cue Differences for the Transfer Test

Sources of Cue	T	Probability
Graphic stimulus plus picture cue vs. graphic stimulus only	2.27	$p < .05$
Graphic stimulus plus picture cue vs. graphic stimulus plus context cue	.98	not significant
Graphic stimulus only vs. graphic stimulus plus a context cue	1.46	not significant

Table 16.
Analysis of Variance for the Transfer Test

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	1.22	1.22			
Cue	2	100.56	50.28	3.23	2/103	$p < .05$
High-Low	1	224.04	224.04	14.37	1/103	$p < .001$
Sex	1	7.64	7.64			
List Type × Cue	2	123.58	61.79	3.96	2/103	$p < .025$
List Type × High-Low	1	11.86	11.86			
List Type × Sex	1	11.53	11.53			
Cue × High-Low	2	48.15	24.07			
Cue × Sex	2	6.70	3.35			
High-Low × Sex	1	36.31	36.31			
List Type × Cue × High-Low	2	46.38	23.19			
List Type × Cue × Sex	2	11.87	5.93			
List Type × High-Low × Sex	1	89.65	89.65	5.75	1/103	$p < .025$
Cue × High-Low × Sex	2	48.43	24.21			
List Type × Cue × High-Low × Sex	2	5.36	2.68			
Residual	103	1605.77				
Total	126	2379.05				

Table 17.

Mean Number of Correct Responses for Each List Type and Cue for the Transfer Test

Cue	Minimal Contrast Lists		Maximal Contrast Lists	
	Mean	S.D.	Mean	S.D.
Graphic Stimulus only	3.11	2.69	1.59	2.91
Graphic Stimulus plus Picture Cue	5.33	6.63	3.67	4.12
Graphic Stimulus plus Context Cue	2.22	1.78	4.81	5.13

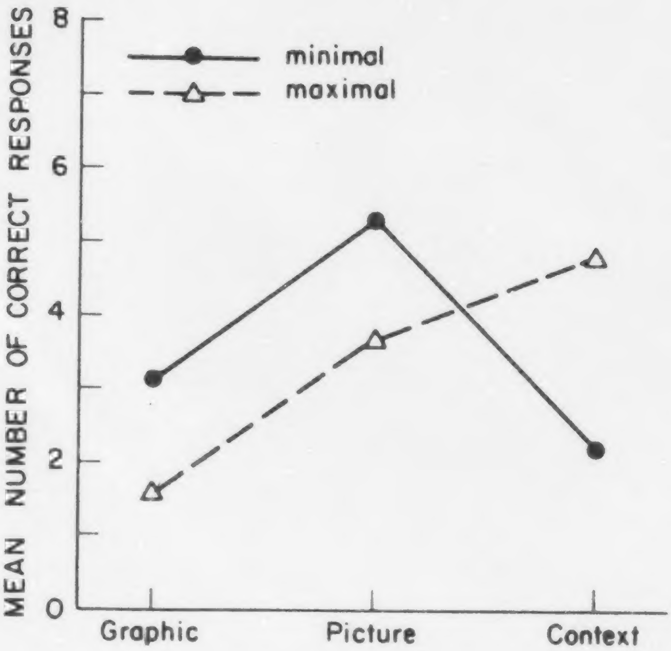


Figure 11. Transfer Test: Mean Number of Correct Responses on Each List Type and Cue.

The three-way interaction of minimal and maximal contrast list types, high and low ability grouping, and sex was significant ($F = 5.75$, $p < .025$). The mean number of correst responses for boys and girls in the high and low ability groups on minimal and maximal lists are presented in Table 18. The boys in the high ability group made higher scores on maximal contrast lists and the girls in the high ability group made higher scores on minimal contrast lists. In the low ability group the boys made higher scores on minimal contrast lists and the girls made slightly higher scores on maximal contrast lists. Figure 12 presents the effect of the interaction.

Table 18.

Mean Number of Correct Responses Made by Boys and Girls in High and Low Ability Groups on Minimal and Maximal Contrast List Types for the Transfer Test

List Type	Sex	High Mean	High S.D.	Low Mean	Low S.D.
Minimal Contrast Lists	Boys	4.32	5.92	2.67	7.58
	Girls	5.00	5.52	2.19	1.72
Maximal Contrast Lists	Boys	6.73	6.48	1.21	1.51
	Girls	3.29	3.42	2.54	2.48

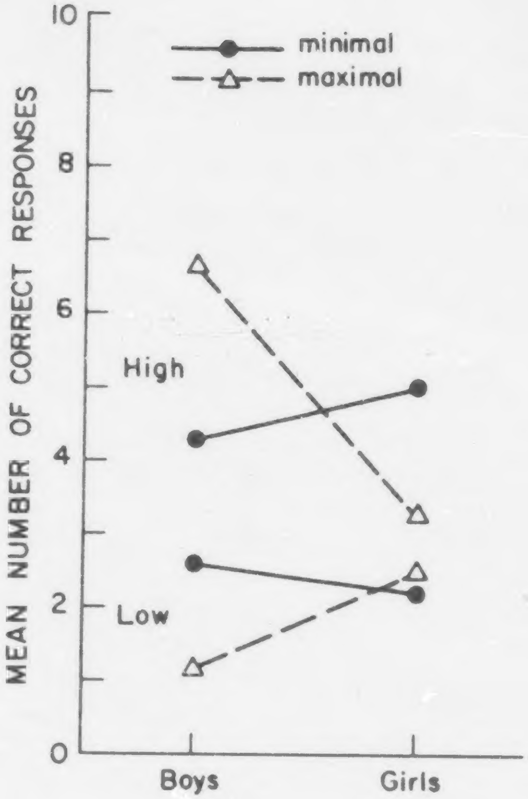


Figure 12. Transfer Test: Mean Number of Correct Responses Made by Boys and Girls in the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

CHAPTER IV

Discussion of the Results for the Correct Answer Analyses

The data from the learning test trials, the twenty-four hour test, the posttest, and the transfer test were analyzed separately. The independent analyses were used to determine if the same pattern of achievement would be evident on the tests.

The analysis of the data indicated the results on the tests followed a similar pattern. Table 19 presents the statistically significant variables and the level of their significance.

Main Effects. Only the main effect of high and low ability grouping was significant on all tests. The high ability group did significantly better on all tests than did the low ability group. This difference was expected. Figures 13a, 13b, 13c, and 13d show the performance of the subjects in the high and low ability groups on each list type and cue for each test. Although there were some differences in the patterns of performance between the high and low ability groups, these variations in pattern were minimal and not significant. Therefore, it appeared from the results of this experiment that although the list type and cue variables affect the level of performance, they do not significantly affect the pattern of learning for the different ability groups.

On the transfer test the main effect of cue was also significant. (See Table 15b for the mean number of correct responses for each cue.) Those subjects who were presented the graphic stimulus plus a picture cue during the study trials made the highest overall scores on the transfer test, and those who were presented the graphic stimulus only

Table 19.

The Significant Variables for the Correct Answer Analyses

	Learning Test Trials		Twenty-four Hour Test		Posttest		Transfer Test	
Sources of Variation	F	Probability	F	Probability	F	Probability	F	Probability
High-Low	55.45	$p < .0001$	50.56	$p < .0001$	55.09	$p < .0001$	14.37	$p < .001$
Cue							3.23	$p < .05$
List Type × Cue	4.52	$p < .025$	4.98	$p < .01$	3.33	$p < .05$	3.96	$p < .025$
List Type × Sex					4.32	$p < .05$		
List Type × High-Low × Sex	3.17	$p > .05$	4.55	$p < .05$	5.54	$p < .025$	5.75	$p < .025$

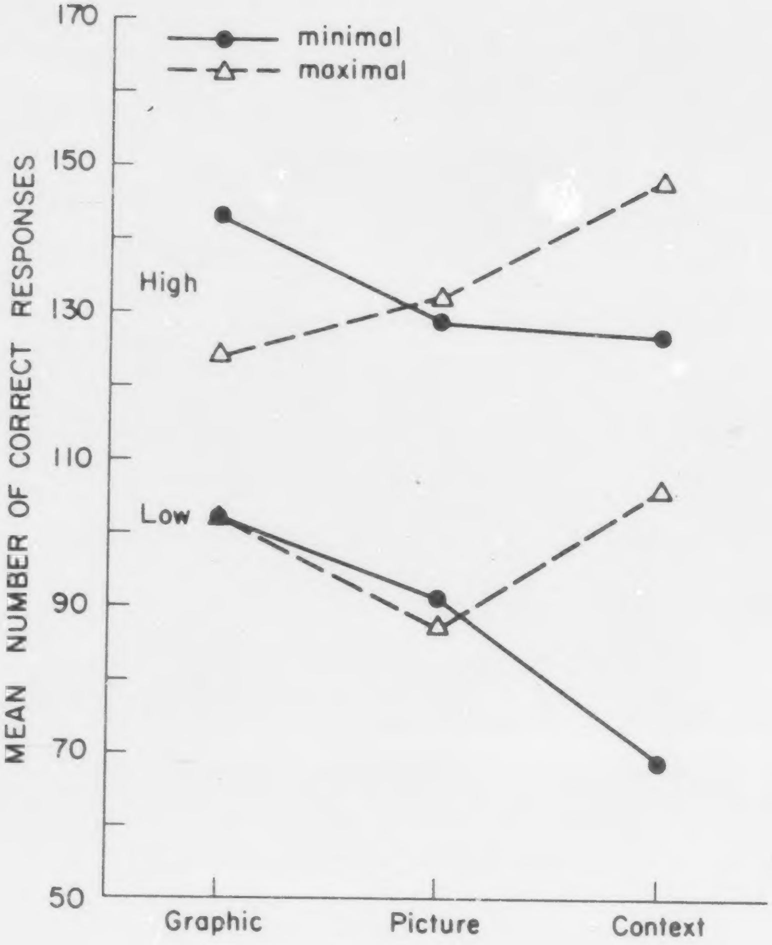


Figure 13a. Learning Test Trial: Mean Number of Correct Responses Made by the High and Low Ability Groups on Each List Type and Cue.

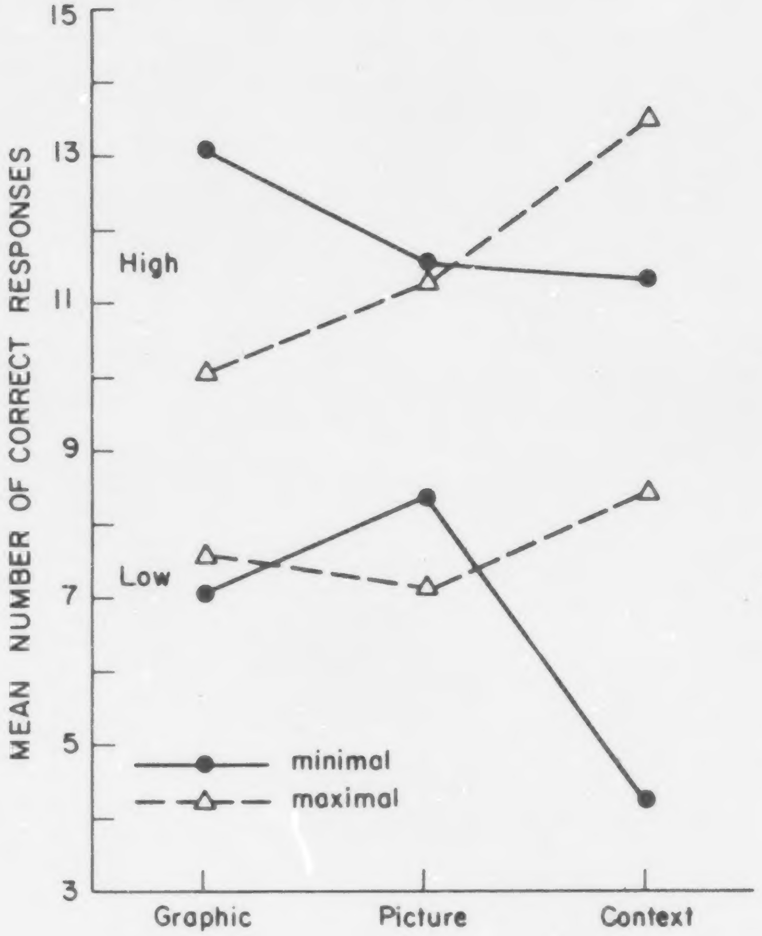


Figure 13b. Twenty-four Hour Test: Mean Number of Correct Responses Made by the High and Low Ability Groups on Each List Type and Cue.

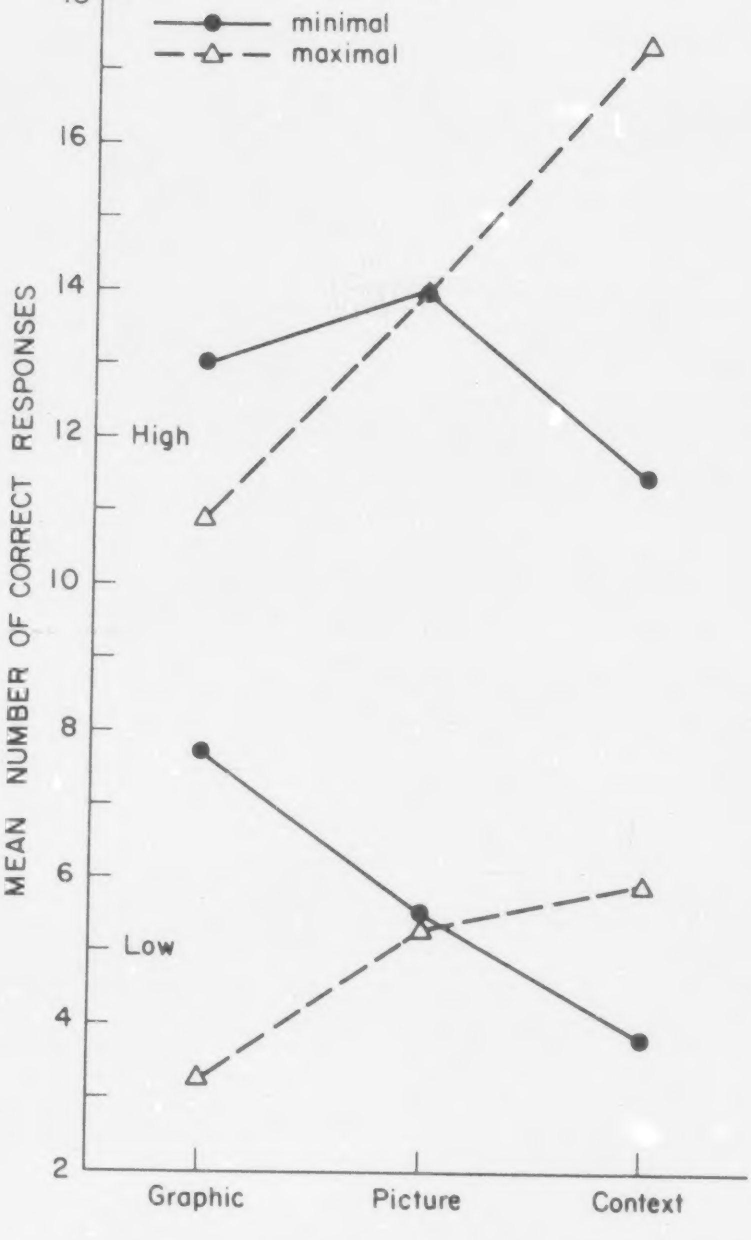


Figure 13c. Posttest: Mean Number of Correct Responses Made by the High and Low Ability Groups on Each List Type and Cue.

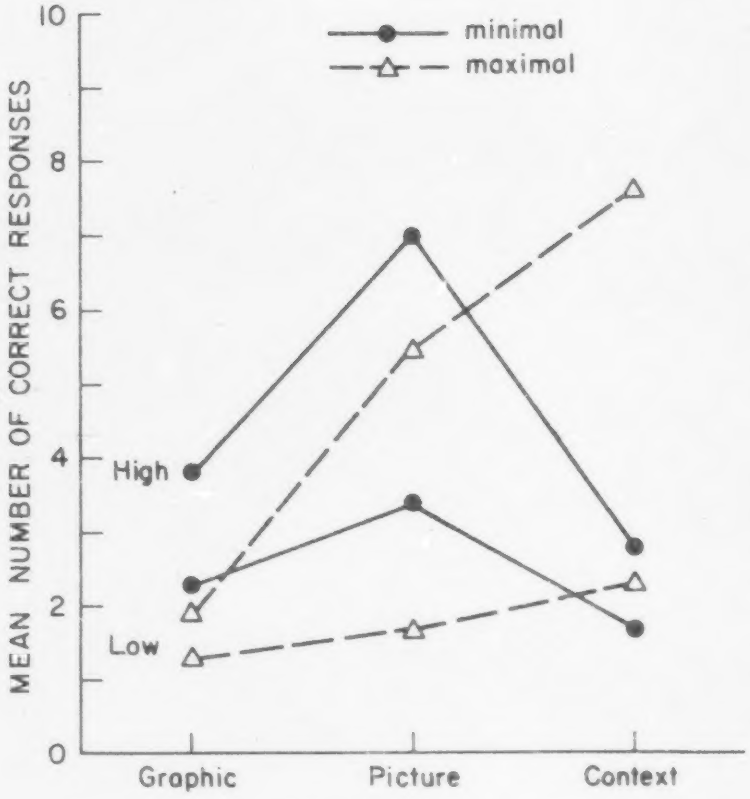


Figure 13d. Transfer Test: Mean Number of Correct Responses Made by the High and Low Ability Groups on Each List Type and Cue.

during the study trials made the lowest overall scores. Figure 14 shows the performance level of the subjects on each cue type.

The use of pictures as cues in initial reading has been supported by Smith (1963). She has maintained that pictures offer the child valuable assistance in making the transition from recognizing an object and naming it to recognizing a symbol that stands for the object and naming it. Heilman (1961) has also stated that pictures are helpful. Bergman and Vreeland (1932) found that children who received their initial reading instruction by the "picture-story" method made superior scores in word recognition.

The use of only a graphic stimulus has been criticized by reading specialists. Tinker and McCullough (1962) have maintained that teaching words in isolation is ineffective. The overall results of this experiment did not support this position because the subjects who received the context cue did not make significantly higher scores than the subjects who received the other two sources of cue.

Interactions. The two way interaction of minimal and maximal contrast list types and cue was significant on all tests. Figure 15 shows the effect of the interaction on each of the tests. The results indicated that when only a graphic stimulus was presented to the subjects during the study trials, this cue was most successful with minimal contrast lists. This outcome supports the work by Fries (1963) and Bloomfield and Barnhart (1961) who have emphasized that the child's attention should center upon making firm connections between the individual sequences of individual letters that make up words. They also

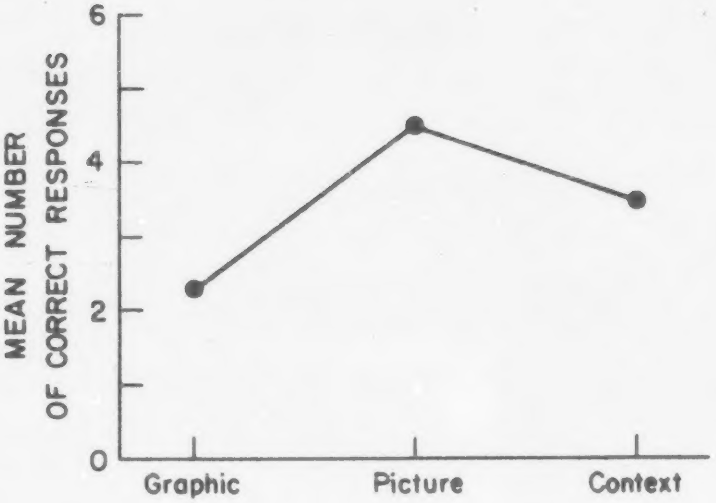


Figure 14. Transfer Test: Mean Number of Correct Responses on Each Cue.

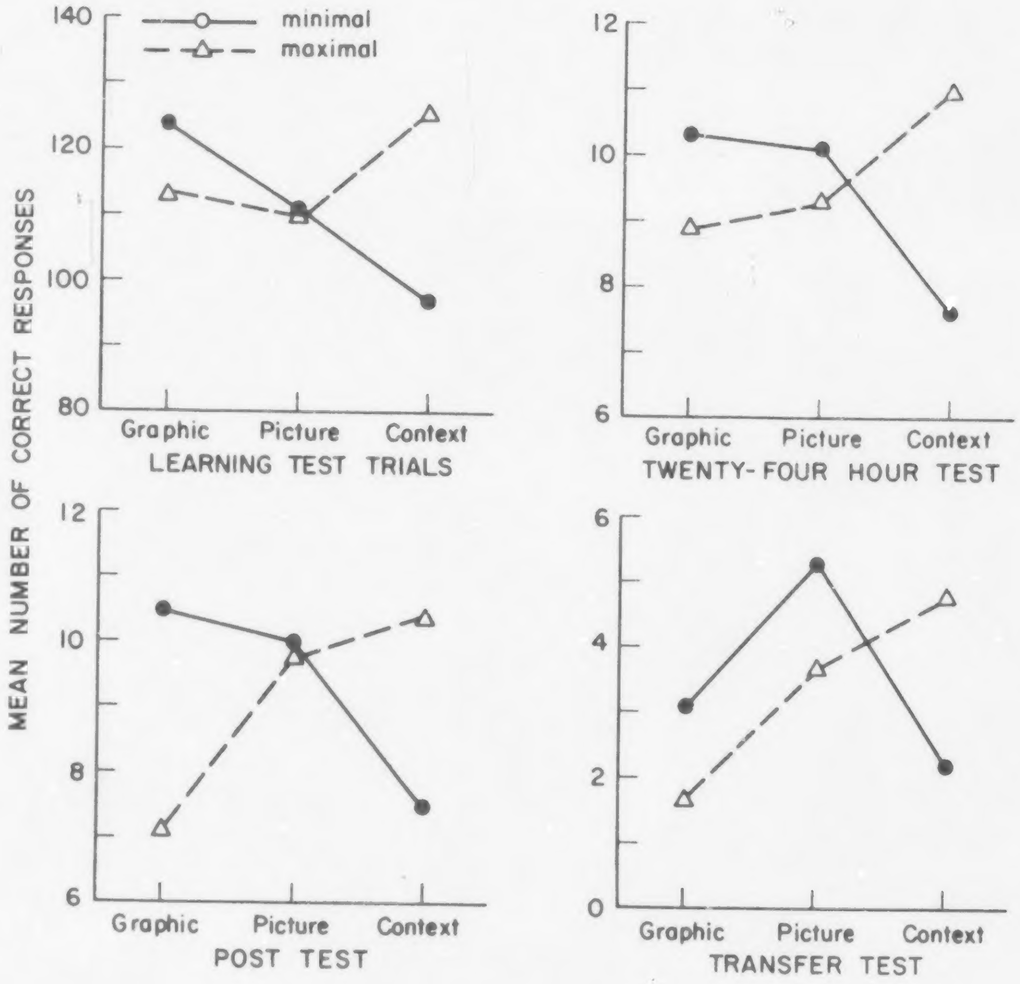


Figure 15. Mean Number of Correct Responses on Each Test for Each List Type and Cue.

urged that instruction concentrate on short words having a regular grapheme to phoneme correspondence.

Since the results of this experiment also showed a lower performance when a graphic stimulus only was presented during the study trials with maximal contrast lists than when it was used with minimal contrast lists, it would indicate that, when only a graphic stimulus is used, the stimulus similarity of minimal contrast lists aided in the learning situation.

When the graphic stimulus plus a picture cue was presented during the study trials, it produced nearly equal results when used with both minimal and maximal contrast lists. This combination produced scores similar to those using only the graphic stimulus with both the minimal and maximal contrast lists on the learning test trials and the twenty-four hour test. On the posttest the graphic stimulus plus a picture cue produced scores similar to those using only the graphic stimulus on minimal contrast lists and higher scores on maximal contrast lists. On the transfer test the graphic stimulus plus a picture cue produced higher scores on both minimal and maximal contrast lists than the graphic stimulus by itself. This result seems to indicate that a picture cue may facilitate learning an initial reading vocabulary.

A graphic stimulus plus a context cue was most successful when presented with a maximal contrast list. Reading specialists such as Gray (1960) and Tinker and McCullough (1962) have asserted that the words a child is learning to read should always be presented in context for the most efficient learning situation. It may be that when a maximal contrast is used, the subject needs additional information such as a context cue to facilitate learning.

The graphic stimulus plus a context cue when used with a minimal contrast list seemed to have a depressing effect. The lowest scores were made by the subjects who received this list type and this cue during their study trials. Fries (1963) and Bloomfield and Barnhart (1961) have stated that context in initial word learning is extraneous and that it places an added burden on the child who should concentrate on making the connections between the visual marks and the speech sounds. They emphasized that by stressing both content and the visual and auditory similarities of words at the same time, a too heavy burden would be placed on the child for the most effective learning situation.

The results of this experiment indicated that, for the optimal learning situation, it is necessary to consider the combination of list type and cue to be used.

The three-way interaction of minimal and maximal list types, high and low ability grouping, and sex was significant on all tests except the learning test trials. Nonetheless, the same pattern on the above interaction did appear on the learning test trials and approached significance. The results indicated that boys in the high ability group were more successful on maximal contrast lists and girls in the high ability group were more successful on minimal contrast lists. This pattern was consistent on all tests.

The performance of the boys and girls in the low ability group was not consistent on all tests. Figure 16 shows the mean number of correct responses made by boys and girls in the high and low ability groups on minimal and maximal contrast lists for each test. On the learning test trials and the twenty-four hour test, both boys and girls were more

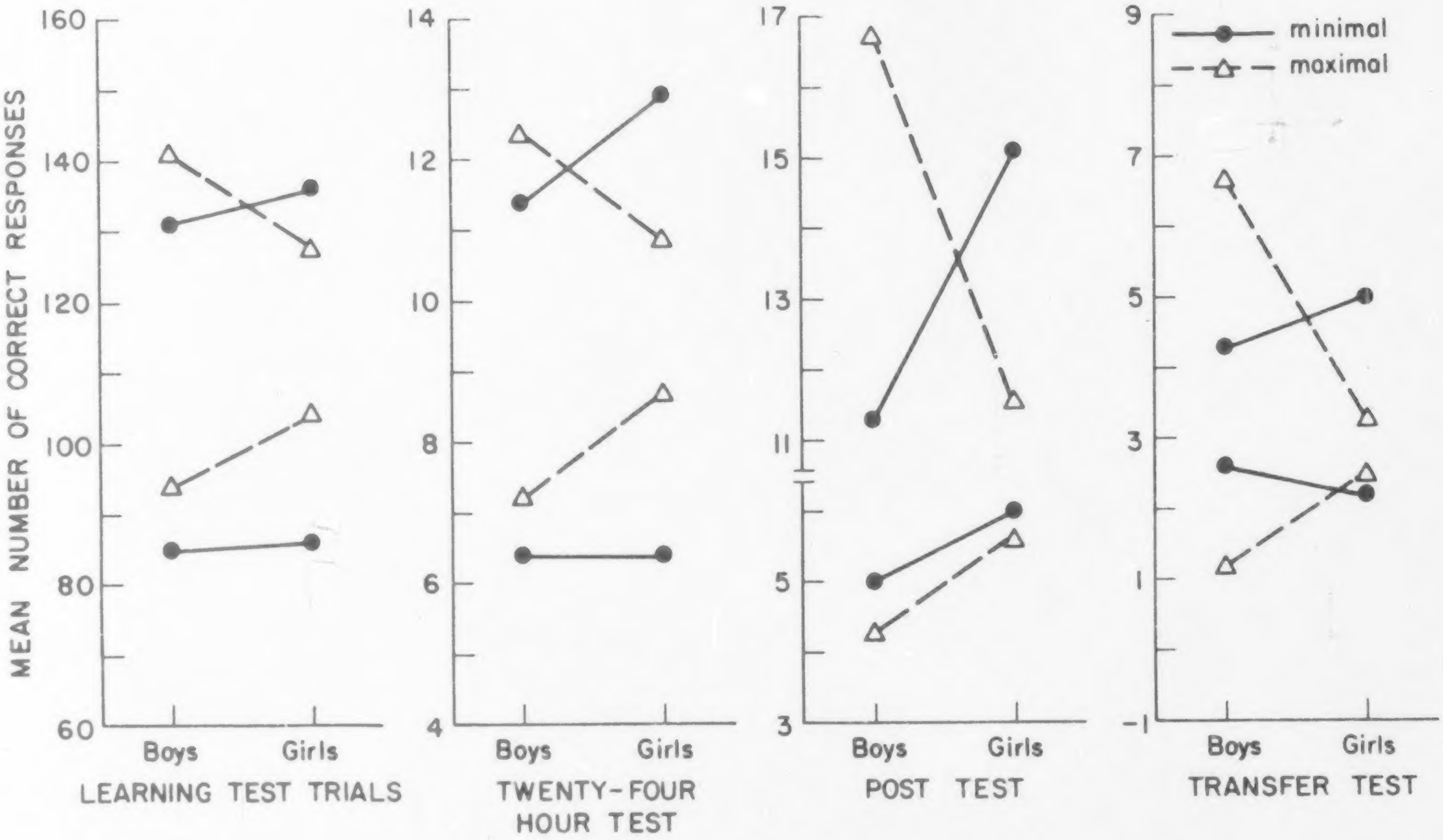


Figure 16. Mean Number of Correct Responses Made by Boys and Girls in the High and Low Ability Groups on Minimal and Maximal Contrast Lists for Each Test.

successful on maximal contrast lists. On the posttest both boys and girls in the low ability group were more successful on minimal contrast lists. The transfer test results indicated that the boys in the low ability group were more successful on minimal contrast lists and that the girls in the low ability group made nearly equal scores on minimal and maximal contrast lists.

An explanation for this result is not possible from the available research. A number of researchers have found that girls generally do better in initial reading than boys. For this experiment, however, this finding was not true because, in general, the overall scores made by boys and girls were nearly equal. The significant sex differences appeared in the form of an interaction with list types and ability groups. Although the reasons for this interaction are not readily available, the differences in performance indicated that consideration should be given to these differences in planning an optimally effective instructional program.

CHAPTER V

Results of the Error Analysis

Each error type was analyzed on a four-way fixed effects fully crossed analysis of variance. The data on each error type for each test was analyzed separately.

The four error types considered were: 1) initial error, 2) final error, 3) total error, and 4) omission. (For a definition of each error type refer to the scoring section in Chapter II.)

Initial Unit Error

Learning Test Trials. The main effect of list type was significant ($F = 92.56$, $p < .0001$). Figure 17 shows that the subject who received minimal contrast lists made significantly more initial unit errors than did those who received maximal contrast lists. The high and low ability grouping main effect was significant ($F = 22.37$, $p < .0001$). The low ability group made significantly more initial unit errors than the high ability group as shown in Figure 18.

The two-way interaction of list type and high and low ability grouping was significant ($F = 20.21$, $p < .0001$). The high ability group made significantly fewer initial unit errors than the low ability group but both groups made more initial unit errors on the minimal contrast lists. The differences between the high and low ability groups on maximal contrast lists were not as large as on minimal contrast lists. Figure 19 shows the effect of the interaction. Table 20 presents the complete analysis of variance table.

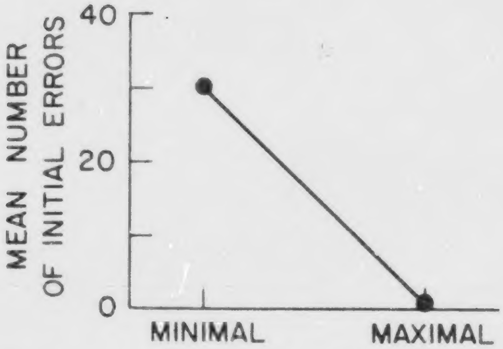


Figure 17. Learning Test Trials: Mean Number of Initial Errors Made on Minimal and Maximal Contrast Lists.

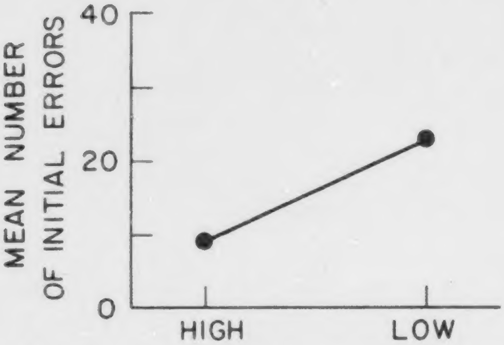


Figure 18. Learning Test Trials: Mean Number of Initial Errors Made by the High and Low Ability Groups.

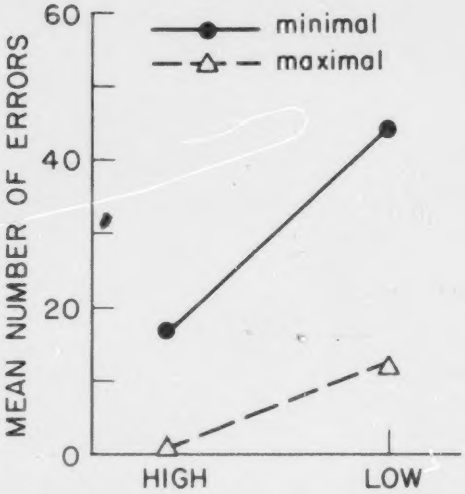


Figure 19. Learning Test Trials: Mean Number of Initial Errors Made by the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

Table 20.
Analysis of Variance for Initial Unit Errors for the Learning Test Trials

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	26528.20	26528.20	92.56	1/103	$p < .0001$
Cue	2	645.88	322.94			
High-Low	1	6504.61	6504.61	22.37	1/103	$p < .0001$
Sex	1	246.21	246.21			
List Type × Cue	2	624.50	312.25			
List Type × High-Low	1	5791.64	5791.64	20.21	1/103	$p < .0001$
List Type × Sex	1	580.88	580.88			
Cue × High-Low	2	22.06	11.03			
Cue × Sex	2	459.63	229.81			
High-Low × Sex	1	113.06	113.06			
List Type × Cue × High-Low	2	.25	.12			
List Type × Cue × Sex	2	462.50	231.25			
List Type × High-Low × Sex	1	138.69	138.69			
Cue × High-Low × Sex	2	287.63	143.81			
List Type × Cue × High-Low × Sex	2	302.25	151.12			
Residual	103	29951.44				
Total	126	72659.43				

Twenty-four Hour Test. The main effect of list type was significant ($F = 12.38$, $p < .001$). The subjects who received minimal contrast lists made significantly more initial unit errors than those who received maximal contrast lists. The difference is shown in Figure 20. The main effect of high and low ability grouping was significant ($F = 14.16$, $p < .001$). The high ability group made fewer initial unit errors than the low ability group as shown in Figure 21.

The two-way interaction of list type and high and low ability grouping was not significant but it did approach significance ($F = 3.43$ with an $F = 3.92$ needed for $p = .05$). This interaction followed the same pattern of performance on the twenty-four hour test as on the learning test trials. Figure 22 shows the difference between the two groups on each list type. The complete analysis of variance is shown in Table 21.

Posttest. Only the main effect of list type was significant ($F = 13.30$, $p < .001$). On this test those who received minimal contrast lists made fewer initial unit errors than those who received maximal contrast lists. The difference is shown in Figure 23. Table 22 presents the complete analysis of variance.

Transfer Test. The main effect of list type was not significant but approached significance ($F = 3.35$ with an $F = 3.92$ needed for $p = .05$). On this test as on the posttest those who received minimal contrast lists made fewer initial unit errors than those who received maximal contrast lists. The difference is shown in Figure 24.

The main effect of high and low ability grouping was significant ($F = 17.15$, $p < .0001$). The high ability group made fewer initial unit

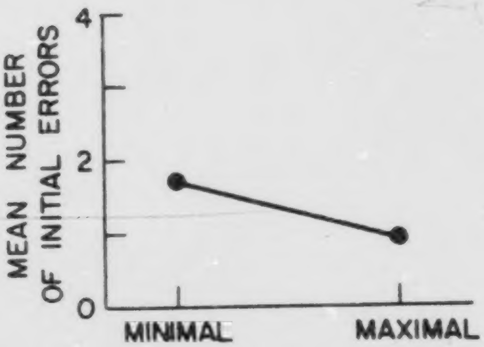


Figure 20. Twenty-four Hour Test: Mean Number of Initial Errors Made on Minimal and Maximal Contrast Lists.

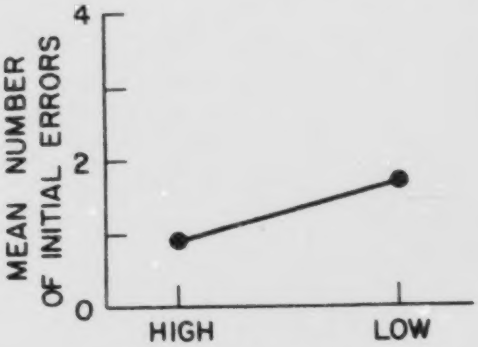


Figure 21. Twenty-four Hour Test: Mean Number of Initial Errors Made by the High and Low Ability Groups.

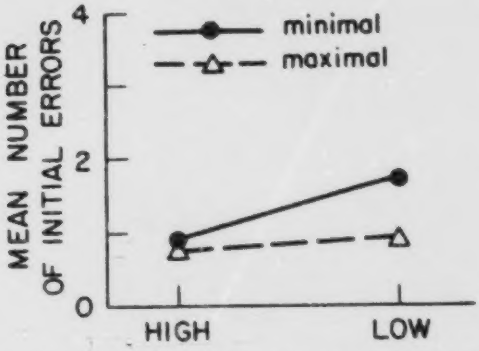


Figure 22. Twenty-four Hour Test: Mean Number of Initial Errors Made by the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

Table 21.

Analysis of Variance for Initial Unit Errors for the Twenty-four Hour Test

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	34.50	34.50	12.38	1/103	$p < .001$
Cue	2	.10	.05			
High-Low	1	39.46	39.46	14.16	1/103	$p < .001$
Sex	1	.64	.64			
List Type × Cue	2	1.05	.52			
List Type × High-Low	1	9.55	9.55	3.43	1/103	$p > .05$
List Type × Sex	1	2.47	2.47			
Cue × High-Low	2	2.47	1.23			
Cue × Sex	2	1.31	.65			
High-Low × Sex	1	.54	.54			
List Type × Cue × High-Low	2	7.05	3.52			
List Type × Cue × Sex	2	3.70	1.85			
List Type × High-Low × Sex	1	.05	.05			
Cue × High-Low × Sex	2	2.04	1.02			
List Type × Cue × High-Low × Sex	2	1.56	.78			
Residual	103	286.99				
Total	126	393.48				

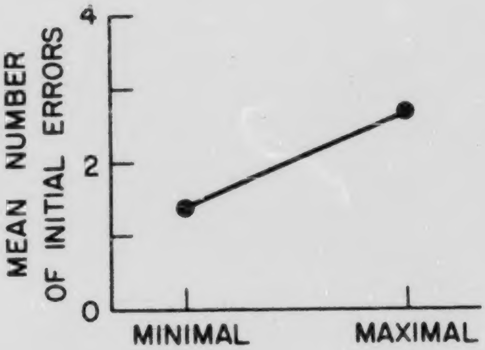


Figure 23. Posttest: Mean Number of Initial Errors Made on Minimal and Maximal Contrast Lists.

Table 22.
Analysis of Variance for Initial Unit Errors for the Posttest

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	58.18	58.18	13.30	1/103	p < .001
Cue	2	5.49	2.74			
High-Low	1	3.74	3.74			
Sex	1	.01	.01			
List Type × Cue	2	9.58	4.79			
List Type × High-Low	1	.19	.19			
List Type × Sex	1	.52	.52			
Cue × High-Low	2	8.86	4.43			
Cue × Sex	2	18.66	9.33			
High-Low × Sex	1	8.27	8.27			
List Type × Cue × High-Low	2	21.03	10.51			
List Type × Cue × Sex	2	13.21	6.60			
List Type × High-Low × Sex	1	2.32	2.32			
Cue × High-Low × Sex	2	23.72	11.86			
List Type × Cue × High-Low × Sex	2	15.53	7.76			
Residual	103	450.42				
Total	126	639.73				

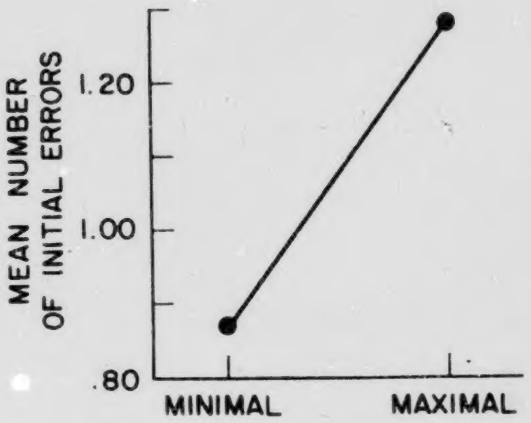


Figure 24. Transfer Test: Mean Number of Initial Errors Made on Minimal and Maximal Contrast Lists.

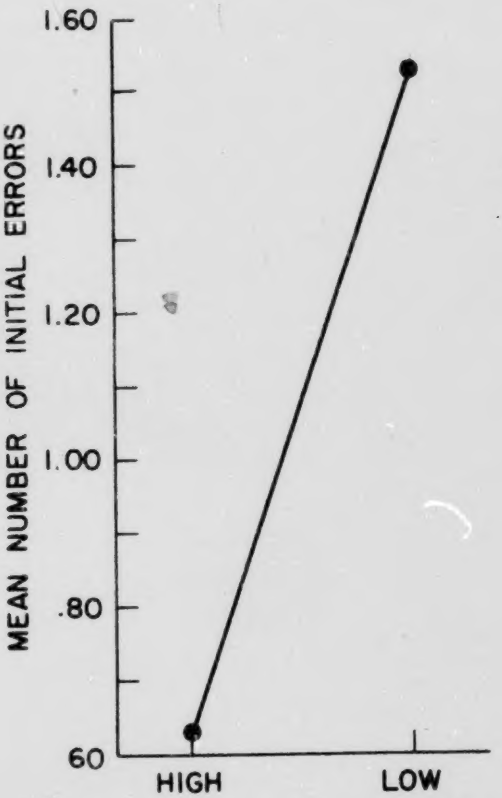


Figure 25. Transfer Test: Mean Number of Initial Errors Made by the High and Low Ability Groups.

errors than the low ability group. The difference is shown in Figure 25. The analysis of variance table is shown in Table 23.

Final Unit Errors

Learning Test Trials. The main effect of cue was significant ($F = 3.41$, $p < .05$). Those subjects who received the graphic stimulus only and the graphic stimulus plus a picture cue during the study trials made fewer final unit errors than those who received a graphic stimulus plus a context cue during the study trials. Figure 26 shows this effect.

The high and low ability grouping effect was significant ($F = 7.04$, $p < .01$). The high ability group made fewer final unit errors than the low ability group as shown in Figure 27.

The two-way interaction of cue and high and low ability grouping was significant ($F = 3.15$, $p < .05$). Figure 28 shows the effect of the interaction. The high ability group made fewer final unit errors on each cue than the low ability group. The high ability group made about the same number of final unit errors on each cue. The low ability group made about the same number of final unit errors on the graphic stimulus only and the graphic stimulus plus a picture cue. The low ability group made more errors on the graphic stimulus plus a context cue. Table 24 shows the analysis of variance table for the final errors on the learning test trials.

Twenty-four Hour Test. On this test none of the sources of variation were significant.

Posttest. The main effect of high and low ability grouping was significant ($F = 6.54$, $p < .025$). The high ability group made more final unit errors than the low ability group. Figure 29 shows the

Table 23.
Analysis of Variance for Initial Unit Errors for the Transfer Test

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	4.89	4.89	3.35	1/103	p > .05
Cue	2	2.12	1.06			
High-Low	1	24.99	24.99	17.15	1/103	p <.0001
Sex	1	1.63	1.63			
List Type × Cue	2	.45	.23			
List Type × High-Low	1	1.34	1.34			
List Type × Sex	1	2.21	2.21			
Cue × High-Low	2	1.30	.65			
Cue × Sex	2	.79	.38			
High-Low × Sex	1	.01	.01			
List Type × Cue × High-Low	2	5.46	2.73			
List Type × Cue × Sex	2	2.51	1.25			
List Type × High-Low × Sex	1	2.57	2.57			
Cue × High-Low × Sex	2	6.86	3.43			
List Type × Cue × High-Low × Sex	2	4.80	2.40			
Residual	103	150.13				
Total	126	212.06				

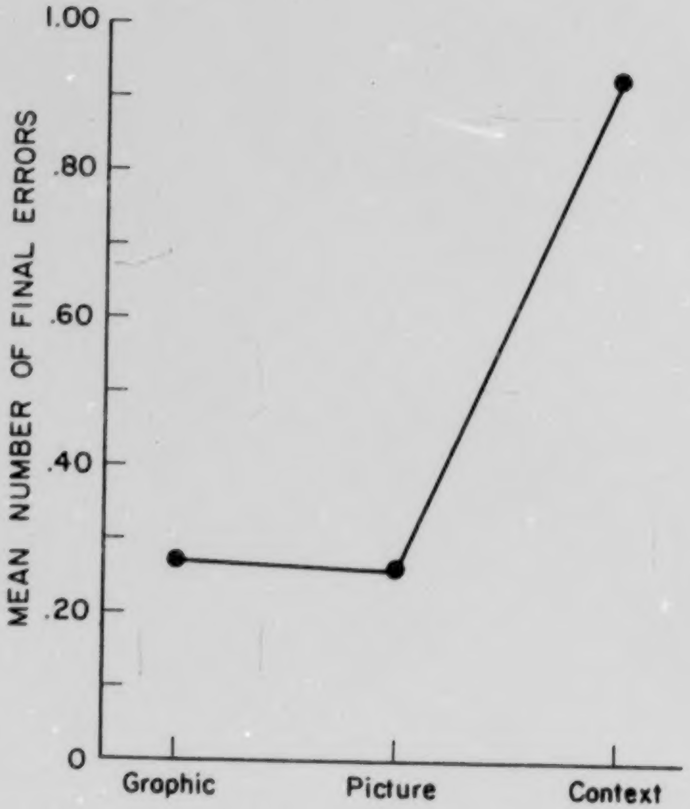


Figure 26. Learning Test Trials: Mean Number of Final Errors Made on Each Cue.

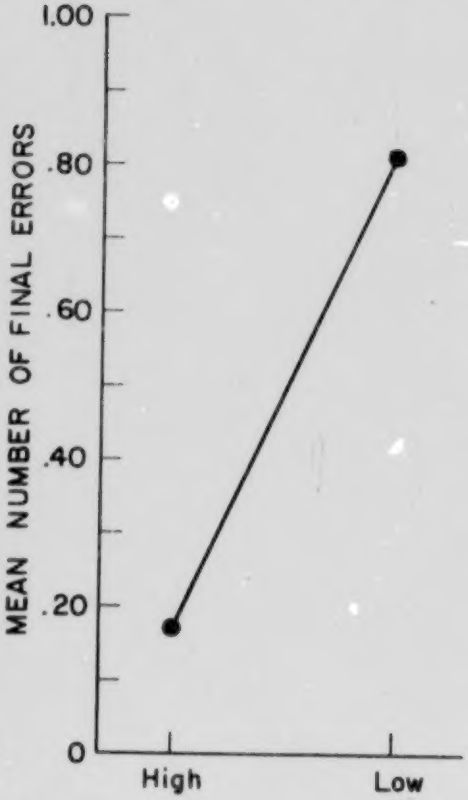


Figure 27. Learning Test Trials: Mean Number of Final Errors Made by the High and Low Ability Groups.

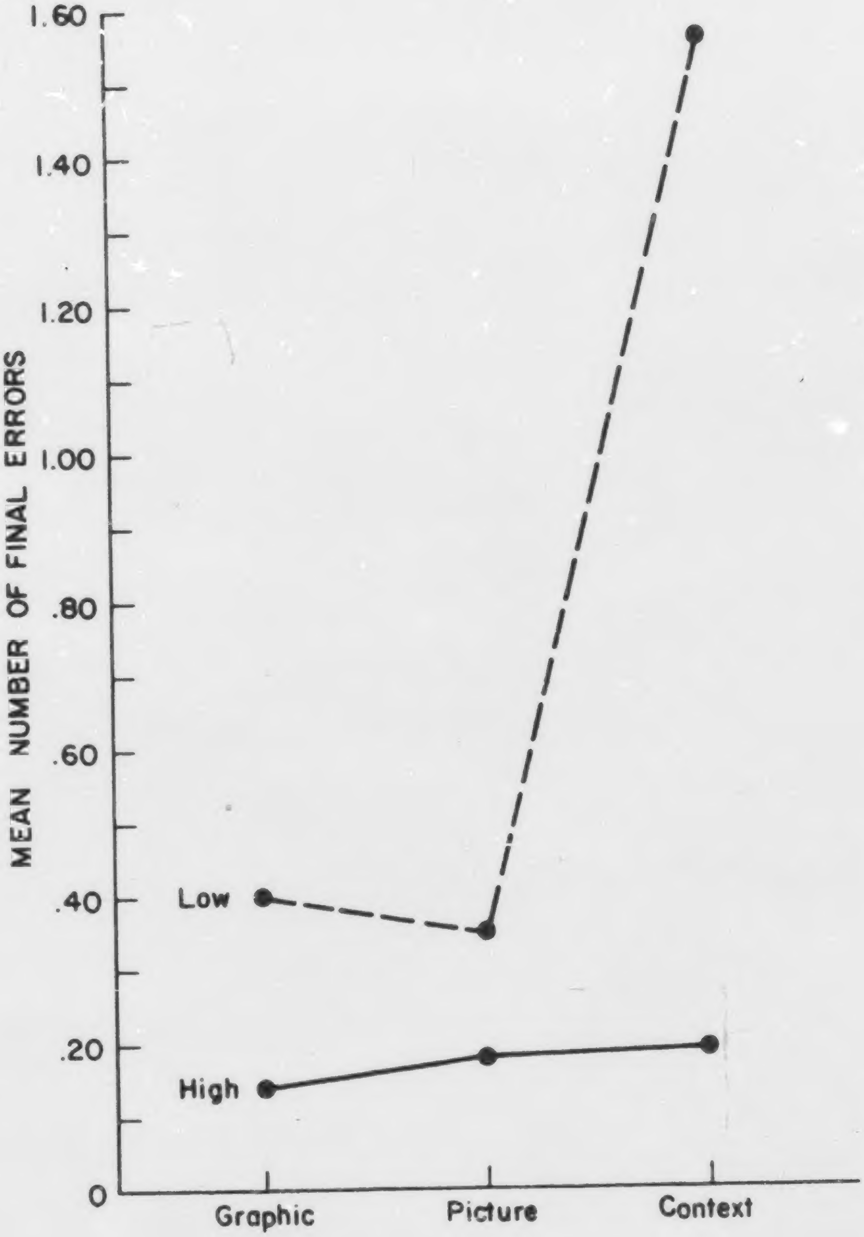


Figure 28. Learning Test Trials: Mean Number of Final Errors Made by High and Low Ability Groups on Each Cue.

Table 24.
Analysis of Variance for Final Unit Errors for the Learning Test Trials

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	1.23	1.23			
Cue	2	11.65	5.82	3.41	2/103	p < .05
High-Low	1	12.04	12.04	7.04	1/103	p < .01
Sex	1	.30	.30			
List Type × Cue	2	9.22	4.61			
List Type × High-Low	1	.60	.60			
List Type × Sex	1	3.21	3.21			
Cue × High-Low	2	10.76	5.38	3.15	2/103	p < .05
Cue × Sex	2	4.90	2.45			
High-Low × Sex	1	4.43	4.43			
List Type × Cue × High-Low	2	6.81	3.40			
List Type × Cue × Sex	2	4.43	2.21			
List Type × High-Low × Sex	1	2.54	2.54			
Cue × High-Low × Sex	2	1.89	.94			
List Type × Cue × High-Low × Sex	2	3.61	1.80			
Residual	103	176.12				
Total	126	253.74				

differences between the two groups. Table 25 presents the analysis of variance table for the final unit errors on the posttest.

The three-way interaction of minimal and maximal contrast lists, high and low ability grouping, and sex approached significance (F = 3.32 with a 3.92 needed for p = .05). Since this interaction has been significant on other tests it merits attention here. The boys in the high ability group made fewer final unit errors on minimal contrast lists and the girls in the high ability group made fewer final unit errors on maximal contrast lists. Both boys and girls in the low ability group made fewer final unit errors on maximal contrast lists. The differences are shown in Figure 30.

Transfer Test. The main effect of high and low ability was significant (F = 17.17, p < .0001). The high ability group made more final unit errors than the low ability group. The difference is shown in Figure 31. Table 26 presents the analysis of variance table for the final unit errors on the transfer test.

Total Errors

Learning Test Trials. The main effect of minimal and maximal contrast list types was significant (F = 25.92, p < .0001). More total errors were made on maximal contrast lists than on minimal contrast lists. The differences on this effect are shown in Figure 32.

The main effect of high and low ability grouping was significant (F = 25.43, p < .0001). As shown in Figure 33, the high ability group made fewer total errors than the low ability group.

The two-way interaction of list type and high and low ability grouping was significant (F = 4.65, p < .05). Figure 34 shows that

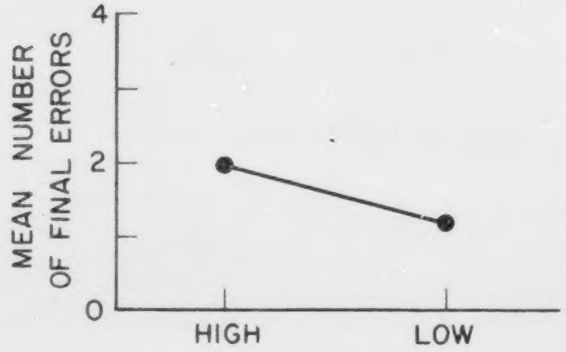


Figure 29. Posttest: Mean Number of Final Errors Made by the High and Low Ability Groups.

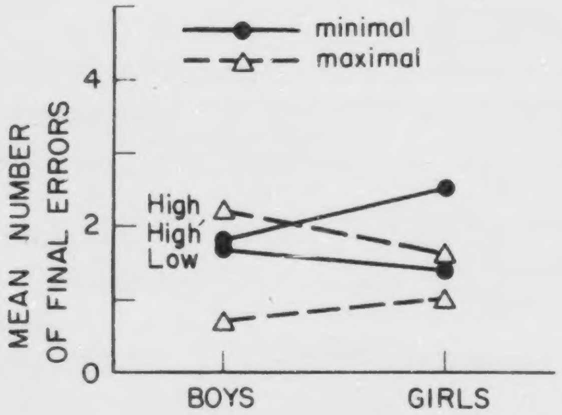


Figure 30. Posttest: Mean Number of Final Errors Made by Boys and Girls in the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

Table 25.
Analysis of Variance for Final Unit Errors for the Posttest

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	7.86	7.86			
Cue	2	4.98	2.49			
High-Low	1	20.66	20.66	6.54	1/103	$p < .025$
Sex	1	.04	.04			
List Type × Cue	2	11.12	5.57			
List Type × High-Low	1	1.87	1.87			
List Type × Sex	1	1.03	1.03			
Cue × High-Low	2	1.62	.81			
Cue × Sex	2	.45	.22			
High-Low × Sex	1	.29	.29			
List Type × Cue × High-Low	2	3.06	1.53			
List Type × Cue × Sex	2	5.13	2.56			
List Type × High-Low × Sex	1	10.49	10.49	3.32	1/103	$p > .05$
Cue × High-Low × Sex	2	6.53	3.26			
List Type × Cue × High-Low × Sex	2	2.40	1.20			
Residual	103	325.18				
Total	126	402.71				

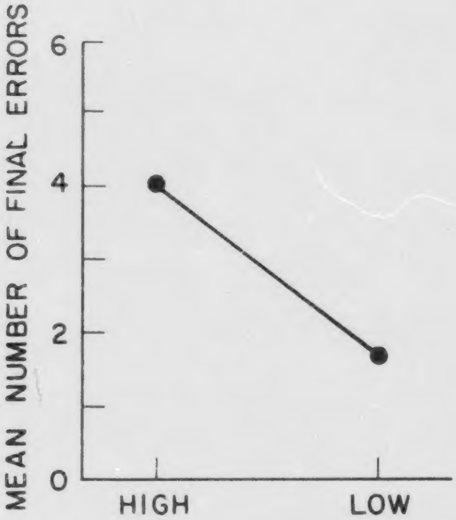


Figure 31. Transfer Test: Mean Number of Final Errors Made by the High and Low Ability Groups.

Table 26.
Analysis of Variance for Final Unit Errors for the Transfer Test

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	11.88	11.88			
Cue	2	1.14	.57			
High-Low	1	169.88	169.88	17.17	1/103	p < .0001
Sex	1	.07	.07			
List Type × Cue	2	15.41	7.70			
List Type × High-Low	1	1.16	1.16			
List Type × Sex	1	7.46	7.46			
Cue × High-Low	2	2.09	1.04			
Cue × Sex	2	7.04	3.52			
High-Low × Sex	1	.48	.48			
List Type × Cue × High-Low	2	13.12	6.56			
List Type × Cue × Sex	2	46.22	23.11			
List Type × High-Low × Sex	1	14.38	14.38			
Cue × High-Low × Sex	2	15.11	7.55			
List Type × Cue × High-Low × Sex	2	28.89	14.44			
Residual	103	1019.21				
Total	126	1353.54				

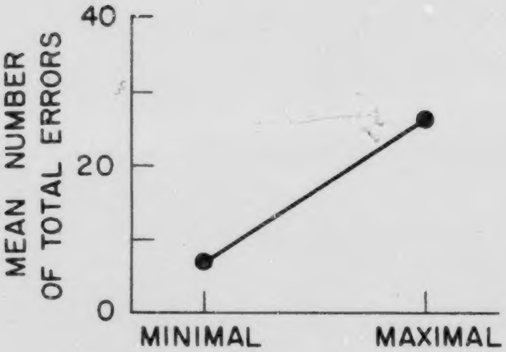


Figure 32. Learning Test Trials: Mean Number of Total Errors Made on Minimal and Maximal Contrast Lists.

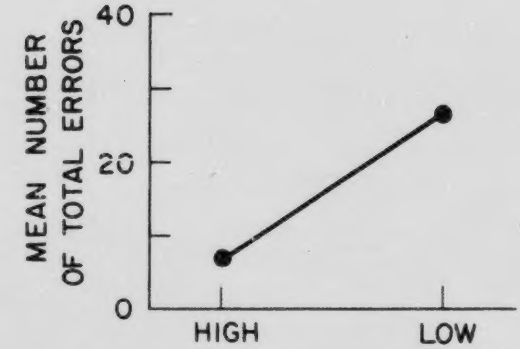


Figure 33. Learning Test Trials: Mean Number of Total Errors Made by the High and Low Ability Groups.

both the high and low ability groups made fewer total errors on minimal contrast lists than on maximal contrast lists.

The three-way interaction of minimal and maximal list types, high and low ability grouping, and sex was significant ($F = 4.19$, $p < .05$). Figure 35 shows the effect of the interaction. Both boys and girls in the high and low ability groups made fewer total errors on minimal contrast lists. The boys and girls in the high ability group who received maximal contrast lists made more total errors than the low ability group who received minimal contrast lists. The low ability group who received maximal contrast lists made many more total errors than the other groups. Table 27 presents the analysis of variance table for the total errors on the learning test trials.

Twenty-four Hour Test. The main effect of high and low ability grouping was significant ($F = 12.31$, $p < .001$). Figure 36 shows the differences in performance between the high and low ability groups. The high ability group made fewer total errors than the low ability group. Table 28 presents the analysis of variance table for the total errors on the twenty-four hour test.

The main effect of minimal and maximal contrast list types approached significance ($F = 3.00$ with a 3.92 needed for $p = .05$). This main effect was significant on the learning trials. The subjects who received minimal contrast lists made fewer total errors than the subjects who received maximal contrast lists as shown in Figure 37.

The two-way interaction of minimal and maximal contrast list types and cue approached significance ($F = 3.06$ with 3.07 needed for a $p = .05$). The subjects who received the graphic stimulus only and the graphic

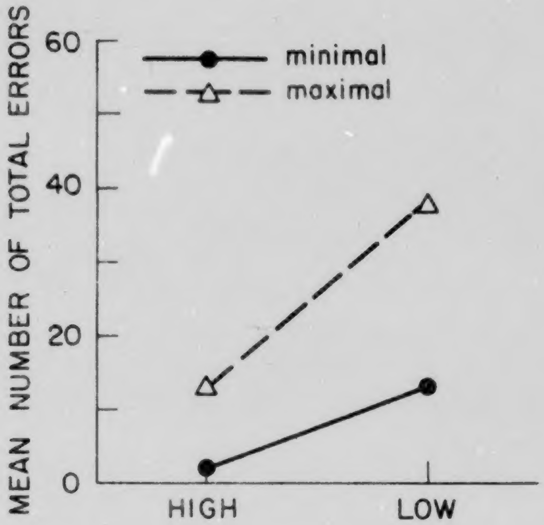


Figure 34. Learning Test Trials: Mean Number of Total Errors Made by the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

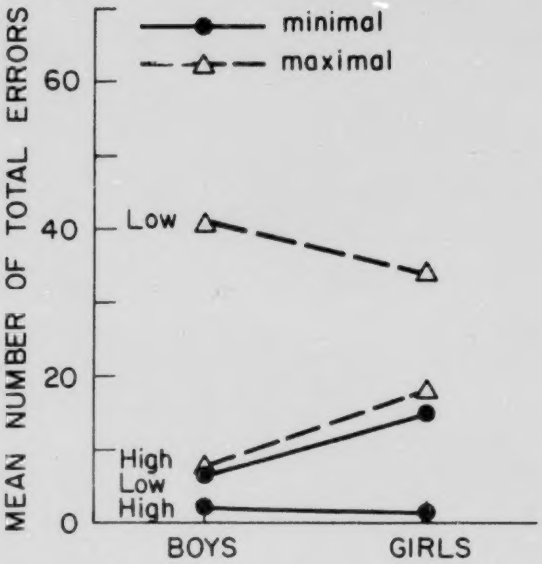


Figure 35. Learning Test Trials: Mean Number of Total Errors Made on Minimal and Maximal Contrast Lists by Boys and Girls in the High and Low Ability Groups.

Table 27.
Analysis of Variance for Total Errors for the Learning Test Trials

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	10920.28	10920.28	25.92	1/103	$p < .0001$
Cue	2	490.44	245.22			
High-Low	1	10714.16	10714.16	25.43	1/103	$p < .0001$
Sex	1	101.25	101.25			
List Type × Cue	2	1914.24	957.12			
List Type × High-Low	1	1959.88	1959.88	4.65	1/103	$p < .05$
List Type × Sex	1	50.64	50.64			
Cue × High-Low	2	1228.32	614.16			
Cue × Sex	2	449.15	224.57			
High-Low × Sex	1	51.72	51.72			
List Type × Cue × High-Low	2	542.99	271.44			
List Type × Cue × Sex	2	1179.83	589.92			
List Type × High-Low × Sex	1	1767.04	1767.04	4.19	1/103	$p < .05$
Cue × High-Low × Sex	2	100.31	50.15			
List Type × Cue × High-Low × Sex	2	718.88	359.44			
Residual	103	43392.75				
Total	126	75581.88				

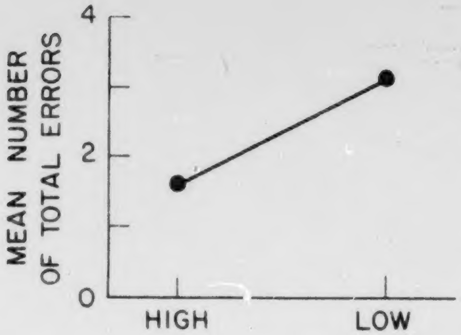


Figure 36. Twenty-four Hour Test: Mean Number of Total Errors Made by High and Low Ability Groups.

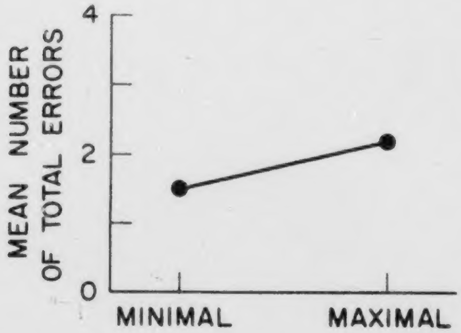


Figure 37. Twenty-four Hour Test: Mean Number of Total Errors Made on Minimal and Maximal Contrast Lists.

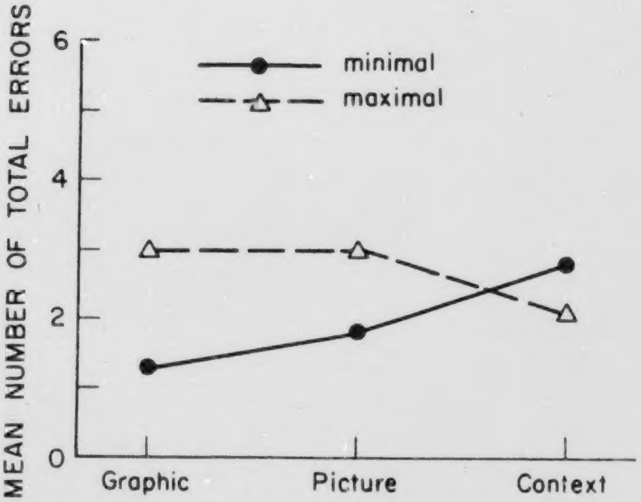


Figure 38. Twenty-four Hour Test: Mean Number of Total Errors Made on Each List Type and Cue.

Table 28.
Analysis of Variance for Total Errors for the Twenty-four Hour Test

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	15.01	15.01	3.00	1/103	p > .05
Cue	2	2.23	1.11			
High-Low	1	69.03	69.03	12.31	1/103	p < .001
Sex	1	.01	.01			
List Type × Cue	2	30.56	15.28	3.06	2/103	p > .05
List Type × High-Low	1	1.11	1.11			
List Type × Sex	1	.72	.72			
Cue × High-Low	2	16.59	8.29			
Cue × Sex	2	17.23	8.61			
High-Low × Sex	1	1.73	1.73			
List Type × Cue × High-Low	2	2.48	1.24			
List Type × Cue × Sex	2	19.21	9.60			
List Type × High-Low × Sex	1	8.17	8.17			
Cue × High-Low × Sex	2	3.08	1.54			
List Type × Cue × High-Low × Sex	2	6.15	3.07			
Residual	103	577.45				
Total	126	770.76				

stimulus plus a picture cue during the study trials with minimal contrast lists made fewer total errors than those who received the same cues with maximal contrast lists. The subjects who received the graphic stimulus plus a context cue during the study trials with maximal contrast lists made fewer total errors than those who received the same cue with minimal contrast lists. The effect of the interaction is shown in Figure 38.

Posttest. The main effect of high and low ability grouping was significant ($F = 11.88$, $p < .001$). The high ability group made fewer total errors than the low ability group. The difference between the ability groups is shown in Figure 39.

The two-way interaction of minimal and maximal contrast list types and sex was significant ($F = 6.52$, $p < .025$). Figure 40 shows the effect of the interaction. Boys made fewer errors on maximal contrast lists than on minimal contrast lists. The girls made fewer errors on minimal contrast lists. The analysis of variance table for the total errors on the posttest are shown in Table 29.

Transfer Test. The main effect of high and low ability grouping was significant ($F = 12.78$, $p < .001$). Figure 41 shows the differences in performance between the two ability groups. The high ability group made fewer total errors than the low ability group. Table 30 presents the analysis of variance table for the total errors on the transfer test.

The three-way interaction of minimal and maximal contrast lists, high and low ability grouping, and sex approached significance ($F = 3.68$ with 3.92 needed for $p = .05$). The boys in the high ability group made fewer total errors on maximal contrast lists. The girls in

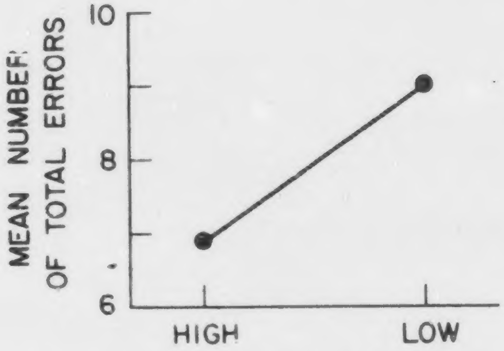


Figure 39. Posttest: Mean Number of Total Errors Made by High and Low Ability Groups.

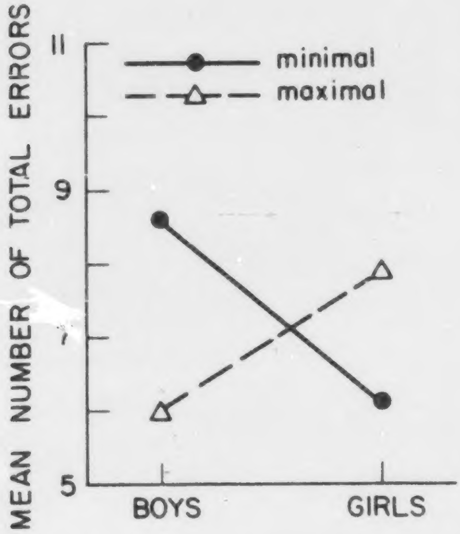


Figure 40. Posttest: Mean Number of Total Errors Made by Boys and Girls on Minimal and Maximal Contrast Lists.

Table 29.
Analysis of Variance for Total Errors for the Posttest

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	10.27	10.27			
Cue	2	33.08	16.54			
High-Low	1	461.81	461.81	11.88	1/103	p < .001
Sex	1	3.77	3.77			
List Type × Cue	2	2.33	1.16			
List Type × High-Low	1	47.88	47.88			
List Type × Sex	1	253.31	253.31	6.52	1/103	p < .025
Cue × High-Low	2	24.77	12.38			
Cue × Sex	2	67.12	33.56			
High-Low × Sex	1	97.59	97.59			
List Type × Cue × High-Low	2	26.27	13.13			
List Type × Cue × Sex	2	136.10	68.05			
List Type × High-Low × Sex	1	3.23	3.23			
Cue × High-Low × Sex	2	57.36	28.68			
List Type × Cue × High-Low × Sex	2	235.81	117.90			
Residual	103	4003.75				
Total	126	5464.45				

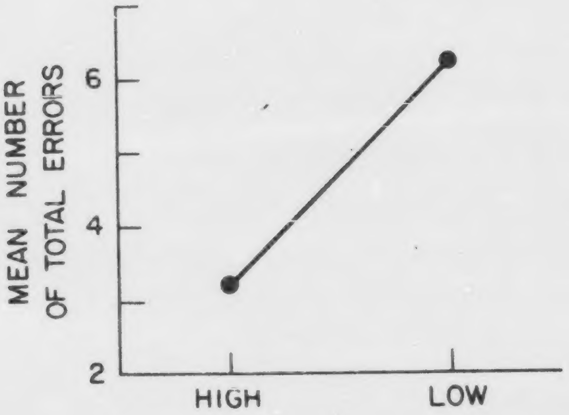


Figure 41. Transfer Test: Mean Number of Total Errors Made by the High and Low Ability Groups.

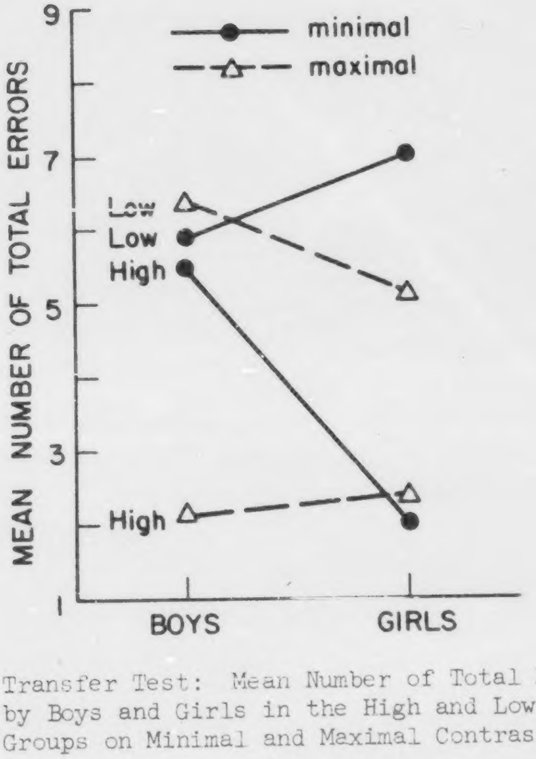


Figure 42. Transfer Test: Mean Number of Total Errors Made by Boys and Girls in the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

Table 30.
Analysis of Variance for Total Errors for the Transfer Test

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	40.48	40.48			
Cue	2	18.05	9.02			
High-Low	1	274.63	274.63	12.78	1/103	$p < .001$
Sex	1	22.84	22.84			
List Type × Cue	2	15.20	7.60			
List Type × High-Low	1	5.48	5.48			
List Type × Sex	1	5.79	5.79			
Cue × High-Low	2	43.40	21.70			
Cue × Sex	2	13.59	6.79			
High-Low × Sex	1	12.39	12.39			
List Type × Cue × High-Low	2	34.11	17.05			
List Type × Cue × Sex	2	34.27	17.13			
List Type × High-Low × Sex	1	79.02	79.02	3.68	1/103	$p > .05$
Cue × High-Low × Sex	2	66.30	33.15			
List Type × Cue × High-Low × Sex	2	91.11	45.55			
Residual	103	2213.98				
Total	126	2970.64				

the high ability group made nearly an equal number of total errors on minimal and maximal contrast lists. Boys in the low ability group made fewer total errors on minimal contrast lists and girls in the low ability group made fewer total errors on maximal contrast lists. The effect of the interaction is shown in Figure 42.

Omissions

Learning Test Trials. The main effect of high and low ability grouping was significant ($F = 8.64$, $p < .005$). The high ability group made fewer omission errors than the low ability group. Figure 43 shows the differences between the two ability groups.

The two-way interaction of minimal and maximal contrast list type and cue was significant ($F = 5.13$, $p < .01$). The effect of the interaction is shown in Figure 44. The subjects who received only the graphic stimulus and the graphic stimulus plus a picture cue with minimal contrast lists made fewer omission errors than the subjects who received the same cues with maximal contrast lists. The subjects who received the graphic stimulus plus a context cue with maximal contrast lists made fewer omission errors than the subjects who received the cue with minimal contrast lists. The analysis of variance table for omissions on the learning test trials is shown in Table 31.

Twenty-four Hour Test. The main effect of high and low ability grouping was significant ($F = 14.61$, $p < .001$). The differences between the two ability groups are shown in Figure 45. The high ability group made fewer omission errors than the low ability group. Table 32 shows the analysis of variance table for omission errors on the twenty-four hour test.

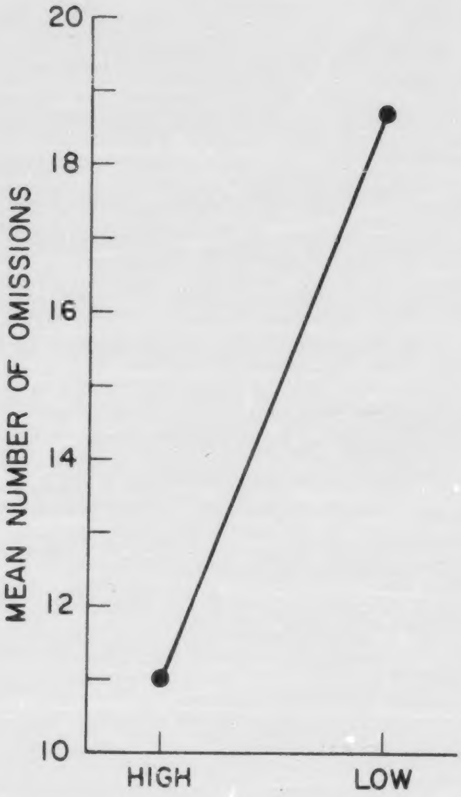


Figure 43. Learning Test Trials: Mean Number of Omissions Made by the High and Low Ability Groups.

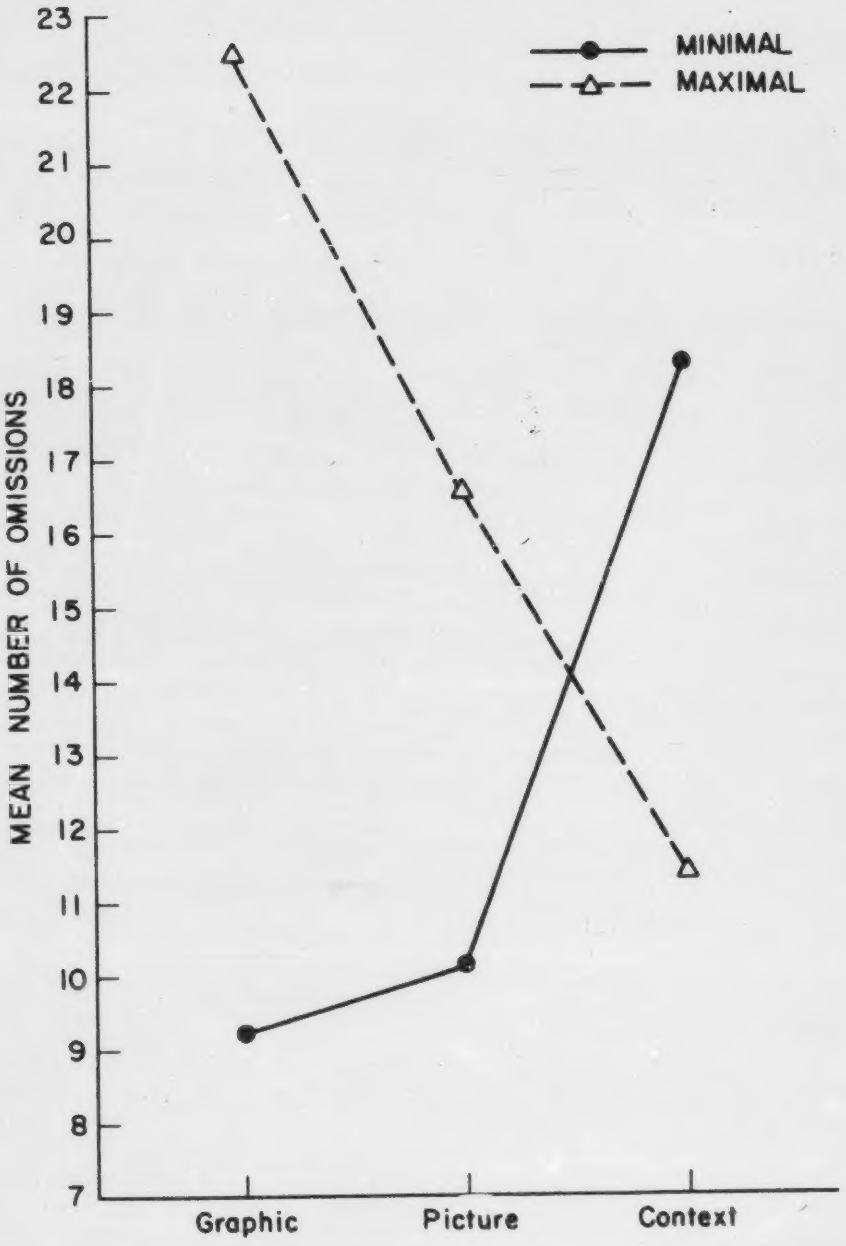


Figure 44. Learning Test Trials: Mean Number of Omissions Made by Subjects on Each List Type and Cue.

Table 31.
Analysis of Variance for Omission Errors for the Learning Test Trials

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	520.64	520.64			
Cue	2	153.96	76.98			
High-Low	1	1902.91	1902.91	8.64	1/103	p < .005
Sex	1	53.40	53.40			
List Type × Cue	2	2257.52	1128.76	5.13	2/103	p < .01
List Type × High-Low	1	30.12	30.12			
List Type × Sex	1	.57	.57			
Cue × High-Low	2	163.61	81.80			
Cue × Sex	2	253.12	126.56			
High-Low × Sex	1	474.54	474.54			
List Type × Cue × High-Low	2	141.95	70.97			
List Type × Cue × Sex	2	99.12	49.56			
List Type × High-Low × Sex	1	.02	.02			
Cue × High-Low × Sex	2	40.23	20.11			
List Type × Cue × High-Low × Sex	2	39.65	19.82			
Residual	103	22677.36				
Total	126	28808.72				

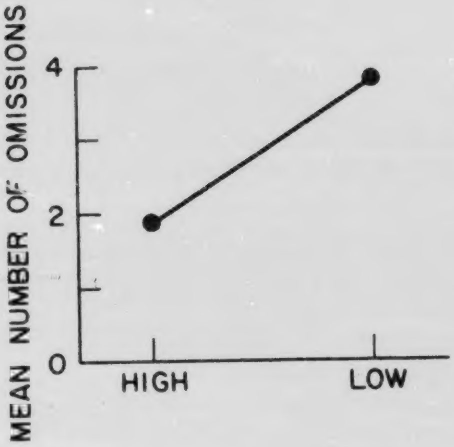


Figure 45. Twenty-four Hour Test: Mean Number of Omissions Made by High and Low Ability Groups.

Table 32.
Analysis of Variance for Omission Errors for the Twenty-four Hour Test

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	.18	.18			
Cue	2	4.46	2.23			
High-Low	1	117.62	117.62	14.61	1/103	$p < .001$
Sex	1	.65	.65			
List Type × Cue	2	36.01	18.00			
List Type × High-Low	1	10.60	10.60			
List Type × Sex	1	.03	.03			
Cue × High-Low	2	10.40	5.20			
Cue × Sex	2	13.93	6.96			
High-Low × Sex	1	12.80	12.80			
List Type × Cue × High-Low	2	3.83	1.92			
List Type × Cue × Sex	2	2.70	1.35			
List Type × High-Low × Sex	1	21.10	21.10			
Cue × High-Low × Sex	2	2.77	1.38			
List Type × Cue × High-Low × Sex	2	2.97	1.48			
Residual	103	829.46				
Total	126	1069.51				

Posttest. The main effect of high and low ability grouping was significant (F = 10.46, $p < .005$). Figure 46 shows the differences between the two ability groups. The high ability group made fewer omission errors than the low ability group.

The two-way interaction of high and low ability grouping and sex was significant (F = 3.93, $p = .05$). Figure 47 shows the effect of the interaction. The boys in the high ability group made fewer omission errors than the girls in the high ability group. The girls in the low ability group made fewer omission errors than the boys in the low ability group. Table 33 presents the analysis of variance table for omission errors on the posttest.

The three-way interaction of minimal and maximal contrast list types, high and low ability groups, and sex approached significance (F = 3.85 with 3.92 needed for $p = .05$). The boys in the high ability group made fewer omission errors on maximal contrast lists. The girls in the high ability group made fewer omission errors on minimal contrast lists. In the low ability group the boys made fewer omission errors on minimal contrast lists and the girls made fewer omission errors on maximal contrast lists. In the low ability group the boys and girls made an equal number of omission errors on minimal contrast lists. The effect of the interaction is shown in Figure 48.

Transfer Test. None of the sources of variation were significant for the omissions made on the transfer test.

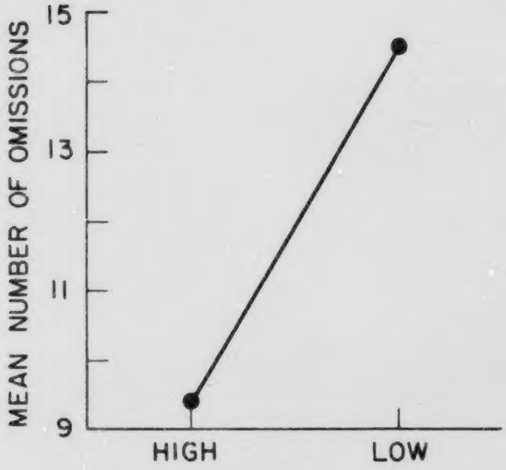


Figure 46. Posttest: Mean Number of Omissions Made by the High and Low Ability Groups.

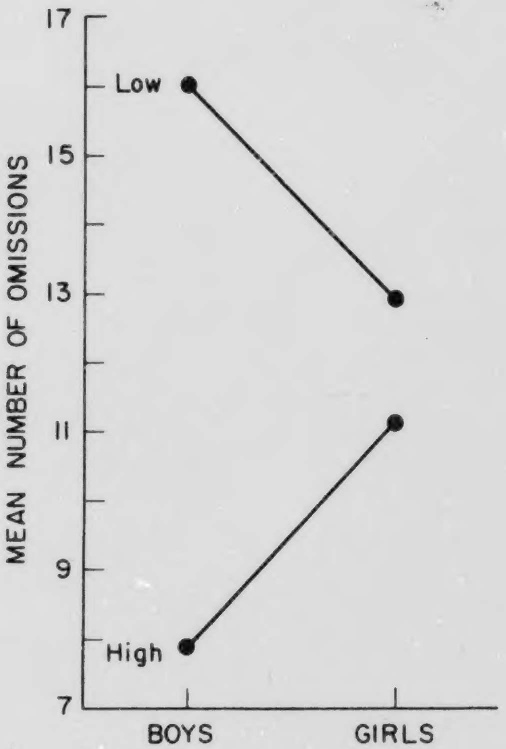


Figure 47. Posttest: Mean Number of Omissions Made by Boys and Girls in the High and Low Ability Groups.

Table 33.
Analysis of Variance for Omission Errors for the Posttest

Sources of Variation	Degrees of Freedom	Sums of Squares	Mean Squares	F	d.f.	Probability
List Type	1	5.30	5.30			
Cue	2	132.79	66.39			
High-Low	1	820.93	820.93	10.46	1/103	$p < .005$
Sex	1	.38	.38			
List Type × Cue	2	416.75	208.37			
List Type × High-Low	1	.21	.21			
List Type × Sex	1	6.57	6.57			
Cue × High-Low	2	54.52	27.26			
Cue × Sex	2	157.12	78.56			
High-Low × Sex	1	308.07	308.07	3.93	1/103	$p = .05$
List Type × Cue × High-Low	2	27.70	13.85			
List Type × Cue × Sex	2	177.11	88.55			
List Type × High-Low × Sex	1	302.82	302.82	3.85	1/103	$p > .05$
Cue × High-Low × Sex	2	6.86	3.43			
List Type × Cue × High-Low × Sex	2	48.14	24.07			
Residual	103	8084.45				
Total	126	10549.72				

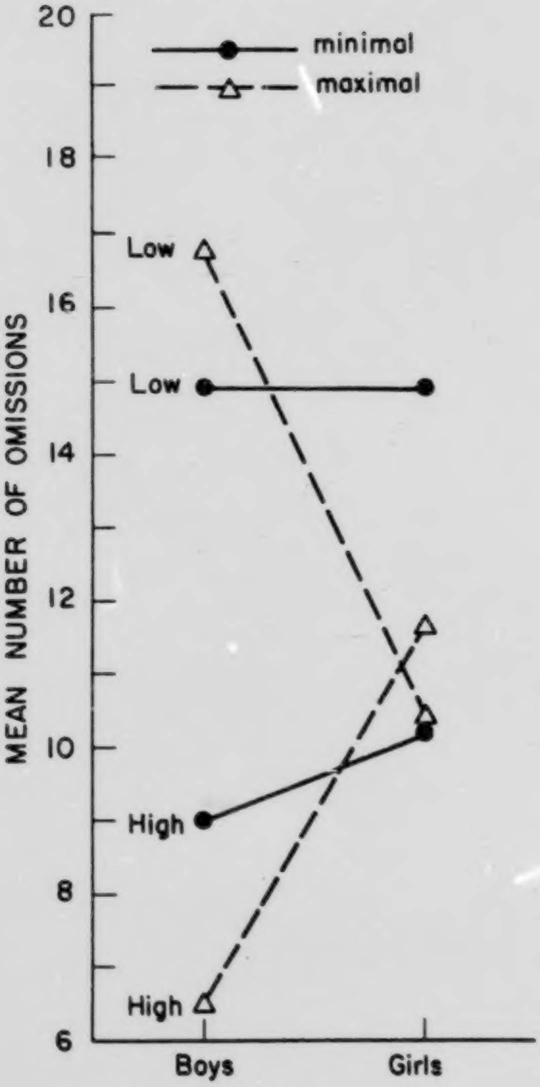


Figure 48. Posttest: Mean Number of Omissions Made by Boys and Girls in the High and Low Ability Groups on Minimal and Maximal Contrast Lists.

CHAPTER VI

Discussion of the Results of the Error Analysis

The data were analyzed for each error type for each test to determine the pattern of error types evident on each test. The error analyses were also done to see if different types of errors were made on the two list types and three sources of cue.

Initial Unit Error

Table 34 presents the statistically significant variables and the level of their significance for the initial unit errors.

Main Effects. The main effect of minimal and maximal list types was significant on all tests. On the learning test trials and the twenty-four hour test those subjects who received minimal contrast lists made more initial unit errors than those subjects who received maximal contrast lists. This result was expected because those subjects who received minimal contrast lists were expected to confuse only the initial elements of the words since the final elements were held constant in each minimal contrast list.

It was interesting to note that on the posttest and the transfer test those subjects who received minimal contrast lists made fewer initial unit errors than those subjects who received maximal contrast lists. This was an expected result in relation to the premise that the use of minimal contrast lists allows the learner to form generalizations about word forms because in the learning situation the subjects were able to concentrate on the initial elements of the word since the final elements were held constant.

Table 34.

The Significant Variables for the Initial Unit Errors

	Learning Test Trials		Twenty-four Hour Test		Posttest		Transfer Test	
Sources of Variation	F	Probability	F	Probability	F	Probability	F	Probability
List Type	92.56	p < .0001	12.38	p < .001	13.30	p < .001	3.35	p > .05
High-Low Ability Grouping	22.37	p < .0001	14.16	p < .001			17.15	p < .0001
List Type × High-Low Ability Grouping	20.21	p < .0001	3.43	p > .05				

The main effect of high and low ability grouping was significant for initial unit errors on all tests except the posttest. Although the differences on the posttest were not significant, the same pattern of performance was evident. The high ability group made fewer initial unit errors than the low ability group.

Interactions. The two-way interaction of minimal and maximal contrast list types and high and low ability grouping was significant only on the learning test trials and approached significance on the twenty-four hour test. The high ability group made fewer initial unit errors than the low ability group on minimal contrast lists. Both the high and low ability groups made more initial unit errors on the minimal contrast lists than on the maximal contrast lists. However, on the maximal contrast lists the initial unit errors made by the high ability group were only slightly fewer than those made by the low ability group.

The fact that both the high and low ability groups made more initial unit errors on minimal contrast lists was consistent with the main effect results that more initial unit errors were made on minimal contrast lists. The fact that there were so few initial unit errors made on maximal contrast lists may account for the slight differences in performance between the high and low ability groups on the maximal contrast lists.

Final Unit Error

Table 35 presents the statistically significant variables for final errors and their level of significance. As shown in the table the statistically significant variables are not consistent on all tests. This may be partially due to the fact that there were proportionally fewer final unit errors than any other type of error.

Table 35.

The Significant Variables for Final Unit Errors

	Learning Test Trials		Twenty-four Hour Test		Posttest		Transfer Test	
Sources of Variation	F	Probability	F	Probability	F	Probability	F	Probability
Cue	3.41	$p < .05$						
High-Low Ability Grouping	7.04	$p < .01$			6.55	$p < .025$	17.17	$p < .0001$
Cue × High-Low Ability Grouping	3.15	$p < .05$						
List Type × High-Low Ability Grouping × Sex					3.32	$p > .05$		

Main Effects. The main effect of cue was significant only on the learning test trials. The subjects who received the graphic stimulus only and the graphic stimulus plus a picture cue made nearly the same number of final unit errors. The subjects who received the graphic stimulus plus a context cue made more errors than those who received the other two cue types. Since this was the only situation in which the main effect of cue was significant, it is difficult to account for the significance. It may be due to the point raised by Bloomfield and Barnhart (1961) that context places an added burden on the learner and may prevent the learner from concentrating on the sequences of letters in words.

The main effect of high and low ability grouping was significant on all tests except the twenty-four hour test. On the learning test trials the high ability group made fewer final unit errors than the low ability group. But on the posttest and the transfer test the high ability group made more final unit errors than did the low ability group. This result is contradictory to the others in this experiment because in all other situations the high ability group made fewer errors than the low ability group. The reason for this result can only be hypothesized. It may be because the number of final unit errors was limited and that the high ability group made more attempts to respond than did the low ability group.

Interactions. The two-way interaction of cue and high and low ability grouping was significant only on the learning test trials. The high ability group made nearly an equal number of final unit errors on each cue. The low ability group made nearly an equal number of final unit errors on the graphic stimulus only and the graphic stimulus plus a picture cue. On the graphic stimulus plus a context cue the low ability group made more final unit errors than on the other cues. The added burden of context appeared to have affected the performance of the low ability group more than it did the performance of the high ability group.

The three-way interaction of minimal and maximal contrast list types, high and low ability grouping and sex approached significance only on the posttest. Since this interaction was significant in other situations it merits attention. The boys in the high ability group made fewer final unit errors on minimal contrast lists and girls in the high ability group made fewer final unit errors on maximal contrast lists. Both boys and girls in the low ability group made fewer final unit errors on maximal contrast lists. An explanation for these differences cannot be given based on any research evidence.

The analysis of the final unit errors is inconsistent in results and therefore it has provided relatively little information on the performance of the subjects.

Total Errors

Table 36 shows the statistically significant variables for the total ~~erro~~rs and their level of significance. As shown in the table the significant variables are not consistent on all tests.

Main Effects. The main effect of list type was significant on the learning trials and approached significance on the twenty-four hour test. More total errors were made by those subjects who received maximal contrast lists. The subjects who received minimal contrast lists were able to make fewer total errors because the final elements of the words were

Table 36.

The Significant Variables for the Total Errors

	Learning Test Trials		Twenty-four Hour Test		Posttest		Transfer Test	
Sources of Variation	F	Probability	F	Probability	F	Probability	F	Probability
List Type	25.92	$p < .0001$	3.00	$p > .05$				
High-Low Ability Grouping	25.43	$p < .0001$	12.31	$p < .001$	11.88	$p < .001$	12.78	$p < .001$
List Type × High-Low Ability Grouping	4.65	$p < .05$						
List Type × Sex					6.52	$p < .025$		
List Type × Cue			3.06	$p > .05$				
List Type × High-Low Ability Grouping × Sex	4.19	$p < .05$					3.68	$p > .05$

held constant, making it possible for those subjects to get part of the word correct. Therefore, since those who received minimal contrast lists made more initial errors it is consistent that these subjects should make fewer total errors on these two tests.

The main effect of high and low ability grouping was significant on all tests. The high ability group made consistently fewer total errors than the low ability group. This is consistent with other results on this experiment.

Interactions. The significant interactions for total errors were not consistent on all tests. On the learning trials the two-way interaction of list type and high and low ability grouping was significant. The high ability group made fewer total errors on both list types. Both ability groups made fewer total errors on minimal contrast lists. This result indicated that on the learning trials both ability groups seemed to benefit from use of minimal contrast lists.

The two-way interaction of minimal and maximal contrast list types and sex was significant on the posttest. The boys who received maximal contrast lists made fewer total errors and the girls who received minimal contrast lists made fewer total errors. This interaction was not significant on any other error types. It did appear as a significant interaction on the posttest analyses for correct answers. The interaction on the total errors was consistent with the interaction on the correct answers. The boys made more correct answers on maximal contrast lists which was consistent with their fewer total errors on maximal contrast lists. The girls made more correct answers on minimal contrast lists which was consistent with their fewer total errors on minimal contrast lists.

The two-way interaction of minimal and maximal contrast list types and cue approached significance for the total errors on the twenty-four hour test. This interaction was significant on the twenty-four hour test for the correct answers. The subjects who received the graphic stimulus only and the graphic stimulus plus a picture cue with minimal contrast lists made fewer total errors than those who received these cues with maximal contrast lists. This is consistent with the results for the correct answers on which the subjects who received these cues with minimal contrast lists made more correct answers than those who received the same cues with maximal contrast lists. Those subjects who who received the graphic stimulus plus a context cue with maximal contrast lists made fewer total errors than those who received this cue with minimal contrast lists. This is consistent with the correct answer analysis on which the subjects who received this cue with maximal contrast lists made more correct answers than those who received this cue with minimal contrast lists.

The three-way interaction of minimal and maximal contrast list types, high and low ability grouping, and sex was significant on the learning test trials and approached significance on the transfer test. On the learning test trials the boys and girls in both high and low ability groups made fewer total errors on minimal contrast lists. The number of total errors made by boys and girls in the low ability group on minimal contrast lists and the boys and girls in the high ability group on maximal contrast lists was nearly equal. The boys and girls in the low ability group made more total errors on maximal contrast lists. The total error pattern on this interaction on the transfer test was different than the one on the learning test trials. The boys in the high ability group made fewer total errors on maximal contrast lists. The girls in the high ability group made nearly an equal number of total errors on both minimal and maximal contrast lists. The boys and girls in the low ability group made more total errors than those in the high ability group. The boys in the low ability group made slightly fewer errors on minimal contrast lists. The girls in the low ability group made fewer total errors on maximal contrast lists.

Omission Errors

Table 37 presents the statistically significant variables and the level of their significance for the omission errors on each test. The significant variables are not consistent on all tests.

Main Effects. The main effect of high and low ability grouping was significant on all tests except the transfer test. Although this effect was not significant on the transfer test the same pattern was evident. The high ability group consistently made fewer omission errors than the low ability group.

Interactions. The two-way interaction of minimal and maximal contrast list types and cue was significant only on the learning test trials. The subjects who received the graphic stimulus only and the graphic stimulus plus a picture cue with minimal contrast lists made fewer omission errors than those who received the same cues with maximal contrast lists. The subjects who received a graphic stimulus plus a context cue with a maximal contrast list made fewer omission errors than those who

Table 37.

The Significant Variables for the Omission Errors

	Learning Test Trials		Twenty-four Hour Test		Posttest		Transfer Test	
Sources of Variation	F	Probability	F	Probability	F	Probability	F	Probability
High-Low Ability Grouping	8.64	$p < .005$	14.61	$p < .001$	10.46	$p < .005$		
List Type × Cue	5.13	$p < .01$						
High-Low × Sex					3.93	$p = .05$		
List Type × High-Low × Sex					3.85	$p > .05$		

received the same cue with a minimal contrast list. This interaction was also significant on the correct answer analysis for the learning test trials. The pattern of omission errors on the interaction was consistent with the pattern of correct answers.

The two-way interaction of high and low ability grouping and sex was significant only on the posttest. The boys in the high ability group made fewer omission errors than the girls in the high ability group. The boys in the low ability group made more omission errors than the girls in the low ability group.

The three-way interaction of minimal and maximal contrast list types, high and low ability grouping, and sex was significant on the posttest. In the high ability group the boys made fewer omission errors on maximal contrast lists and girls made fewer errors on minimal contrast lists. In the low ability group the boys and girls made an equal number of errors on minimal contrast lists but the boys made fewer omission errors on minimal contrast lists and girls made fewer omission errors on maximal contrast lists.

Summary of Error Analysis

Main Effects. The main effect of high and low ability grouping was significant in all but three situations and in those a similar pattern of performance was apparent. As would be expected, the high ability group made fewer errors on each error type and test.

The main effect of minimal and maximal list type was significant on all lists for initial errors and on the learning test trials and twenty-four hour test for the total errors. The subjects who received minimal contrast lists made more initial errors on the learning test trials and the twenty-four hour test. This result would be expected because on the minimal contrast lists only the initial elements of the words varied and the final units were held constant. In contrast the subjects who received maximal contrast lists made more total errors on the learning test trials and the twenty-four hour test. This result was also expected since the subjects who received maximal contrast lists worked on words in which both the initial and final elements varied.

The subjects who received minimal contrast lists made fewer initial errors on the posttest and the transfer test than those who received maximal contrast lists. This result would indicate that because the final elements of the words were held constant on minimal contrast lists the subjects were able to concentrate on the initial units, therefore helping the subjects so they were able to make fewer initial errors on the posttest and transfer test. However, on the posttest and transfer test the number of total errors made on each list type was nearly equal.

The other sources of variation which proved to be significant were inconsistently significant on the error types and on the tests so that it is impossible to speculate on their relative merit for determining a pattern of errors made by the subjects on each list type and cue combination.

CHAPTER VII

Summary

The experiment was designed to investigate the relative value of three sources of cue (graphic stimulus only, graphic stimulus plus a picture cue, and graphic stimulus plus a context cue) in combination with two list types (minimal and maximal contrast) as a means of facilitating the acquisition of initial reading vocabulary. In order to evaluate the relative merit of each combination, the subjects who received each treatment were given four types of tests: 1) the learning test trials were used to evaluate their progress during the learning session; 2) a twenty-four hour test was used to evaluate their retention of the words; 3) a posttest was used to evaluate their retention of the words over a longer period of time; and 4) a transfer test was used to evaluate their ability to recognize unpracticed words that used the same initial and final elements as those used in the practiced word lists.

Correct Answer Analyses. The analyses of the correct answers made on each source of cue combined with each list type resulted in three sources of variation which were significant or approached significance on all tests.

The main effect of high and low ability grouping was significant on all tests; the high ability group made more correct responses than the low ability group. The results indicate that the differences in performance were related to the level of performance in general, rather than significantly different patterns of performance on each list type and cue combination.

The two-way interaction of minimal and maximal contrast list types and cue was significant for the correct answers on each test. The same general pattern of performance existed on all tests for this interaction. The subjects who received only the graphic stimulus with minimal contrast lists made more correct answers than those who received this cue with maximal contrast lists. The subjects who received a graphic stimulus plus a context cue with maximal contrast lists made more correct answers than those who received the same cue with minimal contrast lists. The subjects who received the graphic stimulus plus a picture cue made nearly an equal number of correct responses when this cue was presented with either minimal or maximal contrast lists. The performance on the transfer test differed in one respect. The subjects who received the graphic stimulus plus a picture cue made significantly more correct responses than those who received only the graphic stimulus.

The results on this interaction indicate that it is necessary to consider the list type and cue combination to be used for an optimal learning situation.

The three-way interaction of minimal and maximal contrast list types, high and low ability grouping, and sex was significant. The boys in the high ability group made more correct responses on maximal contrast lists on all tests and the girls in the high ability group made more correct responses on minimal contrast lists on all tests.

The low ability group did not present such a consistent pattern over all tests. On the learning test trials and the twenty-four hour test, both boys and girls in the low ability group who received maximal contrast lists made more correct responses. On the posttest both boys and girls in the low ability group made more correct answers on minimal contrast lists. The transfer test results indicate that the boys in the low ability group who had minimal contrast lists made more correct answers than the boys who had maximal contrast lists. The girls made nearly an equal number of correct answers on the transfer test for both the minimal and maximal contrast lists.

Overall sex differences were not evident on this experiment. The differences were evident only in the form of an interaction with list type and ability level. The differences were consistent enough to consider the use of list types in instructional situations. For example, according to the results of this experiment boys in a high ability group should be given instruction on maximal contrast lists and the girls in a high ability group should be given instruction on minimal contrast lists.

The results on the experiment indicate that it is not possible to state that one list type and cue combination is better than another in relation to the original questions asked concerning the relative performance of beginning readers on each list type and cue combination. Instead it is necessary to consider which combinations are to be used. For example, according to the results of this experiment, if a graphic stimulus plus context cue is to be used, it is most successful with maximal contrast lists, or if a graphic stimulus only is to be used, it is most successful with minimal contrast lists.

The results further indicate that in planning an instructional program consideration should also be given to the ability level and the sex of the learner.

The investigator considered the possibility of transfer occurring during the early stage of initial reading vocabulary acquisition. Some transfer did occur in this experiment; and the pattern of correct answers made on the transfer test was similar to the pattern of correct answers on the other tests.

Advocates of the use of minimal contrast lists maintain that the use of this list type facilitates transfer. The results indicated this was true when the minimal contrast lists were used with a graphic stimulus only or with a graphic stimulus plus a picture cue. However, when a graphic stimulus plus a context cue was used there was more transfer with maximal contrast lists than with minimal contrast lists. The results of the transfer test were similar to those of the other tests in that a graphic stimulus plus a context cue produced more correct answers with maximal contrast lists. Nonetheless, the results on this experiment indicate that some transfer did occur.

Error Analysis. The analysis for error types was not consistent over all tests except for one source of variation (i.e., high and low ability groups). The error analysis indicates that the high ability group made fewer errors in each category of error (except the final unit errors) than the low ability group. The fact that the high ability group made more final errors than the low ability group on the posttest and the transfer test may have been related to the number of final errors made. Fewer final errors were made in proportion to the number of errors made on other types of errors, and the high ability group made fewer total errors and fewer omission errors than the low ability group.

However, in general, the high ability group made a significantly lower number of errors than the low ability group.

The main effect of minimal and maximal contrast list types was not significant on the correct answer analysis. In fact, the overall mean number of correct responses on minimal and maximal contrast list types was nearly equal on each test. The main effect of minimal and maximal contrast list types was significant on the initial error analysis and the total error analysis. The subjects who received minimal contrast lists made more initial errors on the learning test trials and the twenty-four hour test than those who received maximal contrast lists. This result was expected because the final elements were held constant and the initial elements varied on the minimal contrast lists. But on the posttest and the transfer test, fewer initial errors were made by those who received minimal contrast lists than by those who received maximal contrast lists. It may be hypothesized that by holding the final elements constant, the subjects were able to concentrate on the initial elements of words and thus were able to make fewer initial errors on longer term retention tests. However, it was interesting that the subjects who received minimal contrast lists made fewer total errors on the learning test trials and twenty-four hour test than those who received maximal contrast lists. The results for the total errors on the posttest and the transfer test were not consistent in that nearly an equal number of total errors were made by subjects who received minimal and maximal contrast lists. However, the fact that those who received minimal contrast lists made fewer total errors on two tests and if the premises for minimal contrast lists are viable, practice on word lists of this type over a longer period of time might enhance a child's ability to generalize about word forms.

It was hoped that differences between minimal and maximal contrast list types would appear on the final error analysis but they did not. Silberman (1964) indicated that generalizations about word forms need to be made over a long period of time. This may be the reason for the lack of differences on minimal and maximal contrast list types for the final error analysis.

Other significant sources of variation on the error analysis were not consistent across tests.

Further investigation is needed on the value of error analysis for this type of experiment when carried out over a longer period of time. Information about the learner's ability to generalize about word forms in initial reading vocabulary acquisition may possibly be acquired from such an analysis of errors.

Further investigation is also needed on the role of other form classes in initial reading vocabulary acquisition as the present study considered only concrete nouns. It would be useful to determine if the performance patterns would be similar for all form classes.

The study also suggests the need for further research on initial reading vocabulary acquisition in which a similar investigation would be carried out over a period of a month rather than a week. The present results indicate that subjects might make generalizations about word forms more readily after practice over an extended period of time.

The present study is but a small step in understanding the combinations of list type and cue which may facilitate initial reading vocabulary acquisition. The study suggests the usefulness of considering these combinations in planning an instructional program for the acquisition of an initial reading vocabulary.

APPENDIX A

Minimal Contrast Lists

List 1

hen
men
pen
ten

List 2

ring
king
wing
swing

List 3

snow
show
crow
bow

List 4

cake
lake
rake
snake

Maximal Contrast Lists

List 5

men
swing
bow
cake

List 6

snake
crow
ring
pen

List 7

snow
lake
hen
wing

List 8

king
ten
show
rake

APPENDIX B

Sentence Material

List 1

1. The hen is sitting on her nest.
2. My father and my uncle are men.
3. A pen is used for writing.
4. Ten is a number.

List 2

1. Mother has a ring on her finger.
2. A king wears a crown on his head.
3. A bird's wing is covered with feathers.
4. Sally is moving back and forth in the swing.

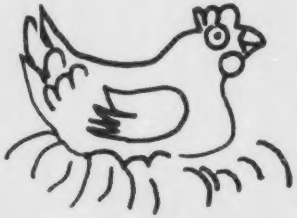
List 3

1. The children liked the show.
2. The snow is white.
3. The crow is a black bird.
4. Nancy had a pink bow in her hair.

List 4

1. Mother baked a cake for my birthday.
2. A lake is water with land all around it.
3. Bobby knows how to use the rake.
4. A snake is a long, skinny animal that crawls.

Appendix B (cont.)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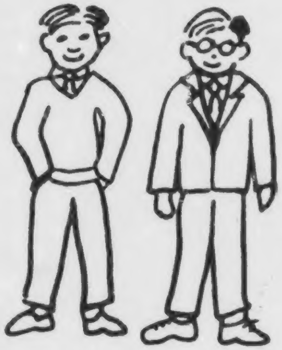
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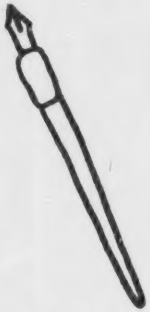
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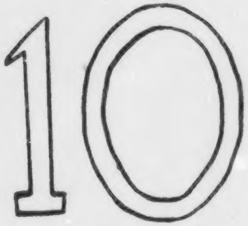
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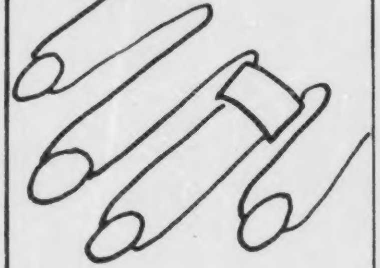
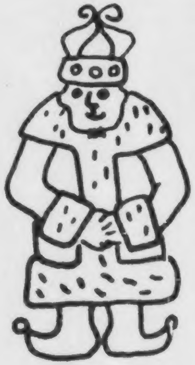

ring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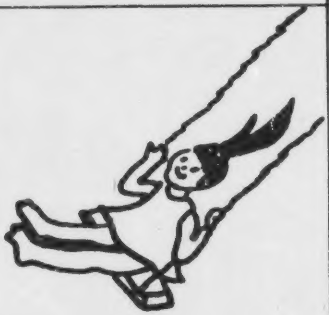
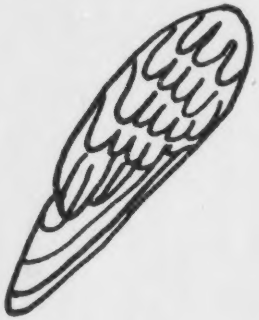
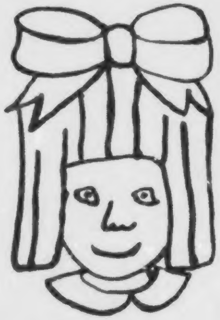
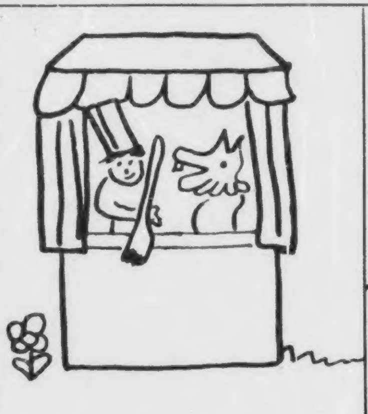
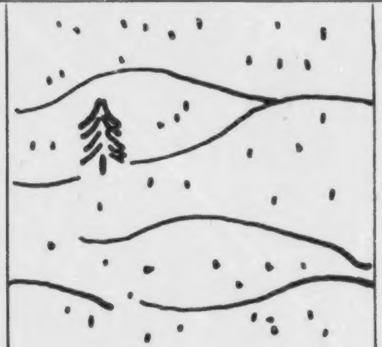

swing

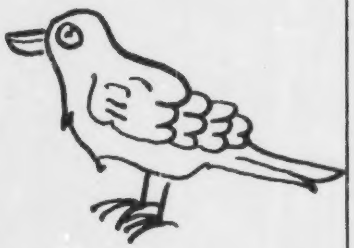

wing

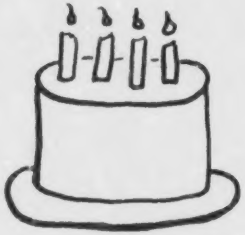
Appendix B (cont.)

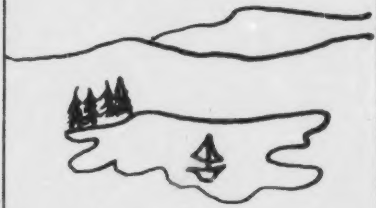

bow

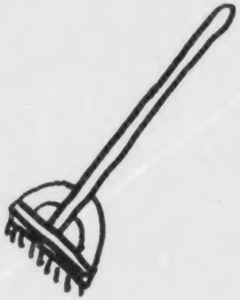

show

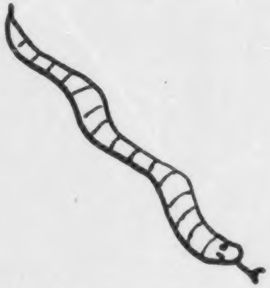

snow


crow


cake


lake


rake


snake

APPENDIX C

Graphic Stimulus Only With Minimal Contrast Lists

hen
ten
men
pen

(Experimenter displays card with word list.) "Here is a list of words. The words end the same way. They rhyme. Look at the words." (Experimenter displays word cards one at a time. Point to the word as you say it.)

Study Trial 1:

This word is *hen*. Look at the word *hen*. Say *hen*.

This word is *men*. Look at the word *men*. Say *men*.

This word is *pen*. Look at the word *pen*. Say *pen*.

This word is *ten*. Look at the word *ten*. Say *ten*.

Test Trial 1: (Present one word at a time.) "Look at the word and say it."

(order of presentation)

pen

men

ten

hen

The study and test trials continued until the subject had received ten study and test trials. The words were randomly ordered for each study and test trial.

Graphic Stimulus Only With Maximal Contrast Lists

men
swing
bow
cake

(Experimenter displays card with word list.) "Here is a list of words. They do not look alike. Look at the words." (Experimenter displays word cards one at a time. Point to the word as you say it.)

Study Trial 1:

This word is men. Look at the word men. Say men.

This word is swing. Look at the word swing. Say swing.

This word is bow. Look at the word bow. Say bow.

This word is cake. Look at the word cake. Say cake.

Test Trial 1: (Present one word at a time.) "Look at the word and say it."

(order of presentation)

cake
bow
men
swing

The study and test trials continued until the subject had received ten study and test trials. The words were randomly ordered for each study and test trial.

Graphic Stimulus Plus a Picture Cue With Minimal Contrast Lists

hen
ten
men
pen

(Experimenter displays card with word list.) "Here is a list of words. The words end the same way. They rhyme. Look at the words." (Experimenter displays picture cards one at a time. Point to the word as you say it.)

Study Trial 1:

This is the picture of a hen. Look at the word hen. Say hen.

This is a picture of men. Look at the word men. Say men.

This is a picture of a pen. Look at the word pen. Say pen.

This is a picture of ten. Look at the word ten. Say ten.

Test Trial 1: (Present one word at a time. Use word cards.) "Look at the word and say it."

(order of presentation)

pen
men
ten
hen

The study and test trials continued until the subject had received ten study and test trials. The words were randomly ordered for each study and test trial.

Graphic Stimulus Plus a Picture Cue With Maximal Contrast Lists

men
swing
bow
cake

(Experimenter displays card with word list.) "Here is a list of words. They do not look alike. Look at the words." (Experimenter displays picture cards one at a time. Point to the word as you say it.)

Study Trial 1:

This is a picture of men. Look at the word men. Say men.

This is a picture of a swing. Look at the word swing. Say swing.

This is a picture of a bow. Look at the word bow. Say bow.

This is a picture of a cake. Look at the word cake. Say cake.

Test Trial 1: (Present one word at a time. Use word cards.) "Look at the word and say it."

(order of presentation)

cake

bow

men

swing

The study and test trials continued until the subject had received ten study and test trials. The words were randomly ordered for each study and test trial.

Graphic Stimulus Plus a Context Cue With Minimal Contrast Lists

hen
ten
men
pen

(Experimenter displays card with word list.) "Here is a list of words. The words end the same way. They rhyme. Look at the words." (Experimenter displays word cards one at a time. Point to the word as you say it.)

Study Trial 1:

The hen is sitting on her nest. Look at the word hen. Say hen.

My father and my uncle are men. Look at the word men. Say men.

A pen is used for writing. Look at the word pen. Say pen.

Ten is a number. Look at the word ten. Say ten.

Test Trial 1: (Present one word at a time.) "Look at the word and say it."

(order of presentation)

pen

men

ten

hen

The study and test trials continued until the subject had received ten study and test trials. The words were randomly ordered for each study and test trial.

Graphic Stimulus Plus a Context Cue With Maximal Contrast Lists

men
swing
bow
cake

(Experimenter displays card with word list.) "Here is a list of words. They do not look alike. Look at the words." (Experimenter displays word cards one at a time. Point to the word as you say it.)

Study Trial 1:

My father and my uncle are *men*. Look at the word *men*. Say *men*.

Sally is moving back and forth in the *swing*. Look at the word *swing*. Say *swing*.

Nancy had a pink *bow* in her hair. Look at the word *bow*. Say *bow*.

Mother baked a *cake* for my birthday. Look at the word *cake*. Say *cake*.

Test Trial 1: (Present one word at a time.) "Look at the word and say it."

(order of presentation)

cake
bow
men
swing

The study and test trials continued until the subject had received ten study and test trials. The words were randomly ordered for each study and test trial.

APPENDIX D

FINAL TEST

Name____________________ Treatment____________________

Instructions: Here are some words you learned last week. Look at the word and say it. (Go through the list twice in the same order.)

	1	2
wing		
hen		
lake		
snow		
rake		
show		
ten		
king		
cake		
bow		
swing		
men		
ring		
pen		
crow		
snake		

APPENDIX E

TRANSFER TEST

Name____________________ Treatment____________________

Instructions: Here are some words. Some of them are real words and some of them are made up words. Look at the word and say it. (Go through the list three times in the same order.)

	1	2	3
sing			
Ken			
make			
row			
ren			
kow			
ling			
hake			

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